ENCE LIBRARY

AUG 25 1924

McGraw-Hill Company, Inc.

August 23, 1924

Twenty-five Cents Per Copy

ENGINEERING AND MINING JOURNAL-PRESS

A CONSOLIDATION OF ENGINEERING AND MINING JOURNAL AND MINING AND SCIENTIFIC PRESS

Interpreting Time-Study Data of Mining Operations

A preliminary to establishing a bonus or piece-work system

By W. F. Dietrich

Chief Engineer, Cia. de Santa Gertrudis, Pachuca, Mexico

Marketing of Rare Metals and Minerals

By H. C. Meyer

Vice-President, Foote Mineral Co., Philadelphia, Pa.

A Glacially Transported Mine

By R. T. Walker

Status of the Shale Oil Industry

By G. W. Wallace

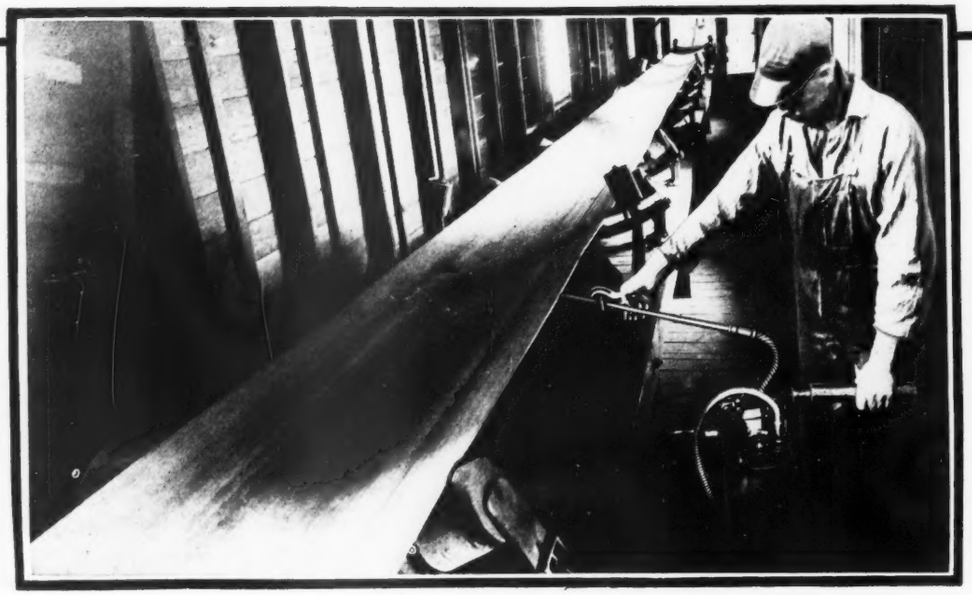
Determination of Lead, Copper and Tin in Drosses

By John H. Hastings

Removing sand and clay in a limestone quarry at Greer, West Virginia

The monitor, which is working under 175-lb. head, is mounted to facilitate its movement about the workings. (See page 302)

THE LATEST DEVELOPMENT IN THE DESIGN OF S-A UNIT CARRIERS



AMID every conceivable kind of competition the S-A Unit Carrier has for years held its enviable leadership in the field of belt conveyor production. This acknowledged supremacy has been attained not through spectacular advertising, nor through high-pressure salesmanship.

Now S-A Unit Carriers, already famous, are available equipped with external lubrication through an approved type of high pressure fitting. This announcement to our customers is made after months of investigation and with the assurance that the S-A Unit Carrier now produced with fittings for high pressure lubrication will elevate the reputation of the carrier to even greater height.

STEPHENS-ADAMSON

AURORA **MFG. CO.** ILLINOIS

ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

Volume 118 | New York, August 23, 1924 | *Number* 8

In Retrospect

TEN YEARS AGO THE WORLD WAR was well upon its way. Prophecy was being flung about freely that it would be a short war, that it would demoralize industry, increase unemployment, and have disastrous effects generally upon business. The Stock Exchange was hurriedly closed as one reflection of this dismal sentiment, and the metal markets began a slump that was not arrested until December, 1914. In fact, for three months no copper quotations were published, an almost unthinkable situation, for even in the most depressed periods metals are bought freely and a market is established. Looking back upon those excited times it is easy to see how groundless were the fears entertained, but most of us recall how appalled and overwhelmed everyone was at the calamity that had befallen the world—and certainly some anxiety was pardonable. The delicate economic adjustment of markets, services, prices, and the many other parts of the business machine were given a jolt from which they have not yet recovered, although it is now six years after the conclusion of hostilities. Some authorities maintain that it will be many years before we shall return to a state of balance again.

After the conflict had settled down to a long-drawn-out affair it became apparent that the metals would be in enormous demand by munitions and war-supply manufacturers, and that this was bound to have a marked upward influence upon prices. Copper, lead, zinc, and tin had a glorious time of it. Twenty-six cent copper, dollar tin, 20c. zinc, 11c. lead. What seeming bliss for the producer! Then the reaction two and three years after the armistice. Copper down to 11⅝c., with most of the industry abandoning operations; zinc at 4½c., lead at 4c., and tin at 26c. Price relations are still seriously disturbed; some think permanently. Lead, the "lowly" metal of the non-ferrous group, for which producers were happy to receive 4 to 5c. before the war, has sold for months above the price of zinc, and no change is in sight. Production of copper was so stimulated during the war that there is a possibility of copper remaining on an entirely new price level compared with pre-war situation. One of the most interesting happenings was the behavior of silver after the termination of artificial control had unleashed the price so that it could follow the mood of the open market. The price of silver rose so high that it sent many foreign silver currencies to the melting pot and threatened to do the same to United States silver coins. This action, incidentally, hurt the market for silver, and it is only now recovering.

When the final balance has been struck it may very well be that the losses of the metal producers after the war outweigh the handsome profits made during the conflict. We are still too close to that period to make an accurate estimate. Copper surely has paid a heavy price for the political unsettlement following the armistice. Only recently has it begun to show signs of substantial improvement, largely on the prospect of the acceptance of the Dawes report by the interested countries. But the great lesson of the last ten years is the frailty of the world's business structure. It is extremely sensitive and delicate to the most subtle and indirect changes. A sharp blow to any part of it is ruinous. The metal markets can testify to this characteristic. A recent illustration was the effort made to stabilize the franc, which accomplished its object, but, in doing so, depressed the price of copper and other metals. The future probably has in store many other examples before we return to that condition so fervently desired and yet so difficult to define—normalcy.

Dust to Prevent Dust Explosions

WHAT promises to be an important market for various producers of nonmetallic minerals is the supplying of dust to prevent explosions in coal mines. The success of the so-called "dusting" method has been demonstrated by the U. S. Bureau of Mines at Pittsburgh and by actual practice in Europe. The addition of inert dust as a diluent in such quantity that the total dust in the entry or gallery consists of 50 to 70 per cent noninflammable material will effectually prevent the propagation of a dust explosion. It is claimed that no such explosions have occurred in British mines since this method has been introduced.

In view of the evident success that results from dusting, an active movement is now on foot to establish the method in the bituminous coal mines of the United States. Utah has taken the lead in making dusting compulsory in all the mines of that state. With such a program in contemplation, a problem of primary importance is the location of supplies of suitable dusting materials. In British practice, roof shale is chiefly used, but in America most of the shale associated with coal is undesirable because too siliceous or too carbonaceous. The ideal dusting material should be light in color, to improve mine illumination and to provide a color contrast as a means of judging the proportion of inert material present. It should also be low in silica and noninflammable. To encourage wide application of the method, the material should be readily available at low cost. Limestone and gypsum are commodities that fulfill all these conditions remarkably well.

As limestone and gypsum fall within the field of activity of the nonmetallic minerals experiment station of the Bureau of Mines at New Brunswick, N. J., that station undertook the task of preparing a series of maps on which are indicated the locations of limestone quarries and gypsum mines contiguous to the chief coal-mining districts. The maps with descriptive text are designed to aid coal-mine operators in securing an adequate supply of mineral dust. The bulletin now awaits publication.

Many limestone quarry operators are faced with the problem of finding a market for a surplus of fines that

cannot be used in finished products. Gypsum mine operators are not confronted with any difficulty in the disposal of fines, but a surplus of off-color or defective gypsum may accumulate. Also, at some gypsum mines the anhydrous form of calcium sulphate, the mineral anhydrite, occurs in large quantities, and it is difficult to find a market for it. Either anhydrite or impure gypsum would serve admirably for coal-mine dusting.

It is noteworthy, therefore, that the general practice of coal-mine dusting would open up an important by-product market for the limestone and gypsum industries. These industries would profit even at very moderate prices, for the products sold might otherwise be wasted. The incentive of encouraging and taking part in the highly humanitarian work of conserving miners' lives, will, it is hoped, deter dusting material producers from taking advantage of an increasing market unduly to advance prices.

An Old Silver Customer Returns

NOT FOR MANY MOONS has better news come to silver producers than the announcement that Germany has arranged to buy 4,000,000 oz. to be used for subsidiary coinage. From high authority comes the statement that 20,000,000 oz. more will be required by the same country for the same purpose in the near future. The fact that four big American companies will supply the silver involved in this transaction does not lessen the importance of the purchase to the smaller producers in this country, and to companies in other countries that mine silver. The big point is that the policy of the German Government is to use silver for coins and that it is able to finance the purchase of the metal.

The recent action of Poland in buying 6,400,000 oz. was a big help, but the German purchase is more significant because of the greater potential consumption by that country. The American silver producers have been trying to find out how much it costs to mine and recover silver and why it costs more than it did; but everybody has been producing just as cheaply as he could, according to his lights, and the best he can do is to continue. The one thing that will increase the selling price is wider use of the metal everywhere and for every purpose. One of the biggest uses will be for coinage; accordingly this purchase by the German Government is about the best excuse for handshaking that silver producers have enjoyed for a long time.

What the Public Feeds On

A DISPATCH from Mexico City which appeared in a prominent New York newspaper explains the existing copper situation in a laughable way. "The causes for production being greater than demand are many," it says. "For instance, Germany and Japan, who were large buyers in the United States and Mexico, are now obtaining their necessities in Russia and under much more favorable conditions. The relative values of the ruble and the dollar, the latter being the basis for all operations, make the price of copper in Russia extremely low as compared with that in the United States. . . . With low-priced copper available in enormous quantities in Russia, the German manufacturers of all classes of articles in which copper is an ingredient are placed at a great advantage when competing with similar industries in North America. The world market is therefore passing to German producers, with the logical result of a copper crisis in the United States and Mexico."

If this dispatch were intended to be taken as a bit of humor it is a complete success. It was printed in the wrong department, however, appearing in the market section. This Russian copper which is supposedly causing all the trouble is as mythical as the golden fleece, or that mysterious fifty-billion-ton deposit of iron ore in the South that recently broke into print. There is no excuse for the publication of such a fool dispatch, especially in New York City, where copper facts may be easily ascertained.

"Suspended From the Curb"

LAST MARCH there appeared on the New York curb market an utter stranger, a virgin stock, which, not to reveal its identity, may be called Prospectors Silver, Ltd. The company, according to the broker's literature, was capitalized for 200,000 shares with a par value of $5. None of this ten-cent stuff with which the curb market is cluttered! This stock was distinctive. The assets of the company were an option to purchase and a long-time lease on certain remotely situated mining property which had produced some rich bonanza ore and which easily may produce again. As to the real merit of the property—because of its spotted character it was admitted to be of largely speculative value—we are not concerned. The usual literature was distributed. One broker's circular had a "latest" telegram from the superintendent reporting the finding of 12 in. of "practically solid metal."

The career of this stock on the curb market, according to the weekly statistics in financial journals, shows a steadily rising quotation, as follows: 6¼, 13⅜, 13½, 13⅝, 14, 15½, 15⅝, 16⅛, 16⅞, 17⅛, 17¾, 22, 23½, and 23½. These, mind you, are all dollars. Weekly sales ranged from 1,600 to 8,300, and totaled for the four-month period about 58,000 shares. There was no regularity in the number of shares that apparently changed hands each week. On June 24 1,400 shares were sold, the price during the day going down from 23 to 22¼, the record shows. On June 25 no trace of Prospectors Silver, Ltd., appeared on the reports of curb transactions, nor has there been any record of it since.

Now, this is the way those who know the ropes interpret the performance of this stock on the curb. The market, they say, was at no time open and free. It was purely artificial. At no time did it reflect the appraisal of the public of the value of the shares. The opening price of $6 was fixed arbitrarily by the backers, who controlled every share of issued stock. Most of the reported sales were in effect fictitious, although brokers, of course, went through all the motions of executing buying and selling orders. The prearranged plan was to send the price to $40. Witness the market letter which says: "The market is today $13.50. Insiders are predicting a $40 market this summer."

Necessarily, some shares were purchased by individuals from that always-paying group designated "the public." At least one lawyer of whom we know put $16,000 of real money into the stock. It is fair to guess that at least $200,000 of outside money came into the market. The price was climbing steadily, and few of the customers cared to sell. Things went swimmingly until

the promoter behind the company decided to go out to the mine. He left sundry funds with his lieutenants to support the market. But with his departure the hitherto trusting outsiders became panicky. Most of them determined to take profits and get out. On June 24 the money left to support the market was exhausted and on June 25 the stock, conveniently, had been "suspended from trading," for the reason that nobody would buy the shares at any price. The Curb Association did not wish to have the quotation go out to the public "Prospectors Silver, asked 22½; bid, nil"; nor would such a quotation suit the promoters of the company. Heads were put together, and the order of suspension from trading was issued quietly.

Since then the broker who sponsored the stock has done some little "over the counter" trading, buying small lots, we have been told, at as low as $2, but of this the general public is not aware, and the average man who owns a few hundred shares is to all intents and purposes without a market. Just how much of the money that the promoter obtained from the public he spent in his effort to support the market he only knows. He is probably not a looser on the transaction.

The legitimate purpose of a stock exchange is to afford a place for people who own shares to exchange them for money at prices which reflect the bona fide demand of real purchasers. Rigging the market with fictitious sales defeats this purpose. Washing sales is against the law of the state and is against the rules of the Stock Exchange; yet no informed person denies that it is done constantly. Among other things, the practice seriously hampers the legitimate financing of mining enterprises.

A Layman Assists the Scientist

THE GRAVITATION of "sharks" to certain densely populated localities on the earth's surface needs no scientific explanation. The discovery of immense numbers of sharks' teeth in the slopes of a small mountain near Kern River, Bakersfield, Calif., by Mr. Charles Morrice, chief clerk for the Pacific Oil Co. in that district, has resulted in the following interesting explanation of their deposition, forming part of a letter from Dr. David Starr Jordan to Mr. Morrice:

"At the northern end of the island on which Wrangel is situated there is a promontory on which is a salmon cannery. To the west of this is a shallow lagoon of salt water, with a channel about 10 ft. deep and a couple of rods wide. Across on the mainland is Stickeen River, white with glacial mud from the glaciers along its course. This mud covers the bottom of the lagoon with fine white deposits, similar to the stuff in which your shark teeth occur.

"Sharks gather around the point for the salmon, and then they sometimes crawl into the lagoon at high tide and rest there. The 25-ft. tide goes and leaves them in the soft white mud to flounder around and finally die. When the tide comes in it brings others, attracted by the odor of the dead fish. I saw three of the great sharks, 20 ft. long, floundering in the mud after a single tide.

"After a few thousand years, when this becomes entirely dried, you will find millions of the teeth of these sharks and of some other fishes that have come to the same place. Something of this sort must have happened in Miocene times in Kern County, when the King and Kern valleys were filled with glaciers."

Mr. Morrice is a fossil enthusiast. In recognition of his services to science one of the sharks of the Miocene age has been named after him with the picturesque cognomen of *Carcharias morricei*. He recently uncovered what was first supposed to be part of the remains of a squalodont, the head and neck of which measures 7 ft. in length, but which has since been identified by Dr. Remington Kellogg, of the National Museum, Washington, D. C., as belonging to a Miocene sperm whale. Dr. Kellogg congratulates Mr. Morrice on the discovery of a location that has yielded the first real pelagic fauna of vertebrates for the entire Pacific Coast; he explains that cretaceans are essentially cosmopolitan in their distribution, descriptions of 500 species having been received from various parts of the world. From this fact may be gaged the possible value of these animals in intercontinental geologic correlation.

It is generally conceded, says Dr. Kellogg, that the remains of mammals afford an excellent indication of horizons; and pelagic animals, because of their wide distribution, will provide evidence that will settle the geologic relationships of various marine formations. The discoveries of Mr. Morrice will enable a thorough comparative study to be made of the fauna of pelagic mammals at Bakersfield, Calif., and those considered equivalent in time on the Atlantic Coast.

An unusual form of recreation is bringing fame and satisfaction to Mr. Morrice, who is to be congratulated on his initiative. Similar opportunities doubtless exist for many other laymen to add to the melting pot of knowledge by co-operating with scientists.

One Kind of Conservation

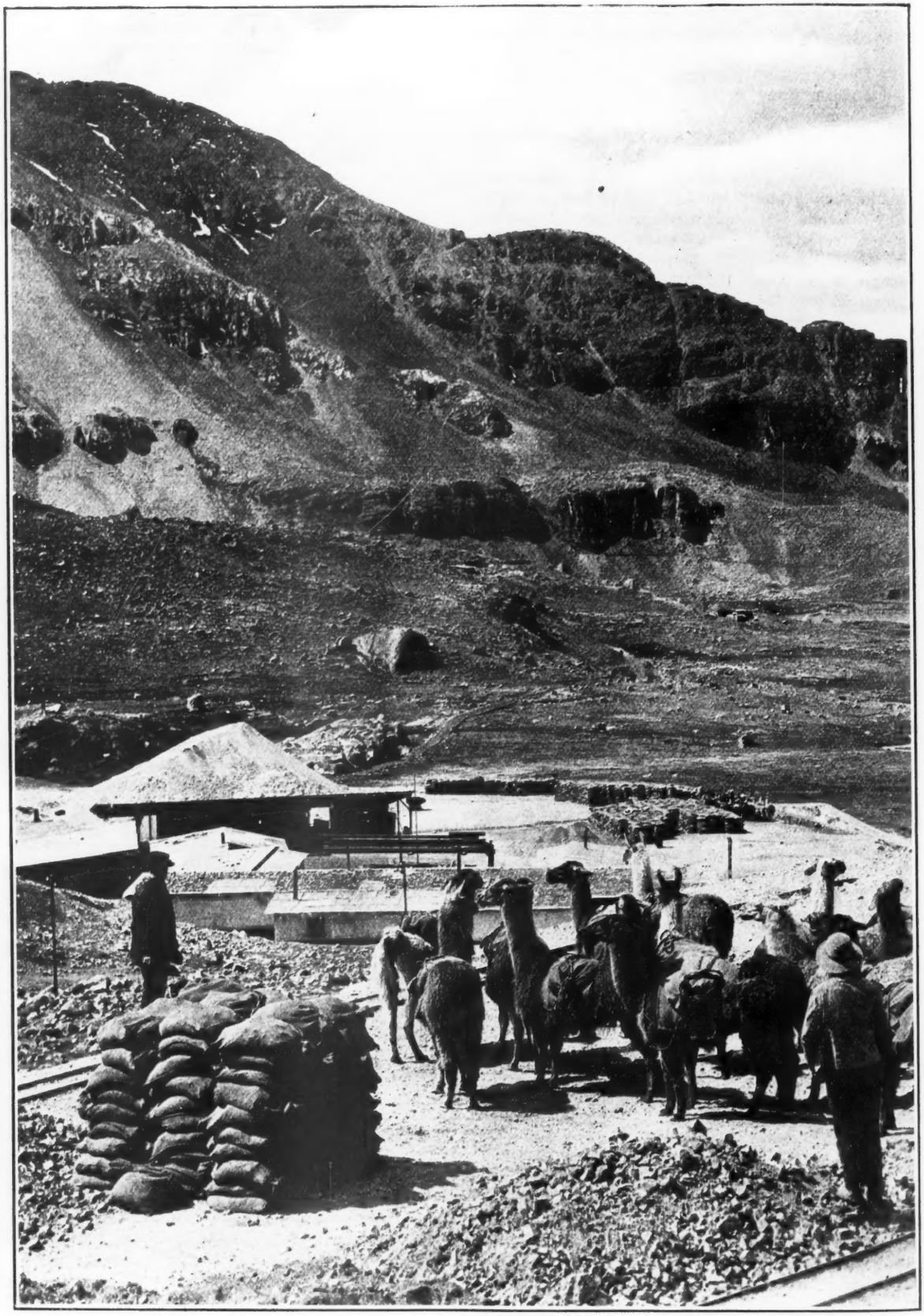
WHEN ED TIMMONS shoveled 1,200 lb. of zinc ore into a mine car in one minute forty-nine and a half seconds to win the recent mucking contest at Butte, he beat fifty-seven expert ore shovelers and established a new record for the "Biggest Mining City in the World." Within six seconds of equaling Timmons' time were W. R. Smith, Alex Gustafson, John Espeland, and "Old Bob" Hossfeld, long, lean, wiry, bald, and the favorite with the crowd. Timmons himself is a slim man past middle age and of only medium height; his remarkable performance was accomplished by the clock-like precision of his movement, by his economy of motion. He seemed to work without great effort. It is not too much to say that he closely approached human perfection in this kind of task.

By alternating short periods of work with longer periods of rest, or by diminishing his pace to an eighth, he would be able to load about eighteen tons of ore in an ordinary shift—a fair day's work in most mines. Suppose—if we may suppose the impossible—that he were to work an eight-hour shift at the maximum rate of which he showed himself capable; he would have moved 145 tons of muck!

And here comes the moral. The same man with a comparatively simple machine of wood and steel and brass, engined with electricity or compressed air, could load double the amount in the same time without unusual effort, or sixteen times as much as the average shoveler usually moves.

Not so many years ago holes were drilled with hand steel, beaten with hammers, swung by human arms. Now, thanks to the manufacturers of air drills, single-jacking and double-jacking are virtually lost arts. Possibly some hand shoveling will always be done around mines, but certainly the day is almost here when all big masses of broken rock will be moved by machines. Human energy is too valuable to be spent at the heart-breaking toil that was the usual lot of the mucker of twenty years ago. It is not that mine workers are getting "soft." It is merely common-sense conservation of human nerve and muscle.

A Llama Pack Train at Morococha, in the Andes of Peru



Operators in the regions of high altitude in South America find these beasts of burden an important factor in the transportation of high-grade ore and supp!

Marketing of Rare Metals and Minerals

Beryl, Monazite, Zircon, Lithium Minerals, Cerium, Beryllium, Germanium, Thallium, Zirconium, Thorium, and Hafnium

By H. C. Meyer
Vice-president, Foote Mineral Co., Philadelphia

THE ELEMENT BERYLLIUM was first known in 1797, discovered in the mineral beryl, a beryllium-aluminum silicate, and was first separated as a metal in 1827. The specific gravity of beryllium is 2.7, and it resembles aluminum closely in its chemical properties. It is an element about which much has been predicted but little accomplished in the way of real commercial uses. It is malleable and light, has a silvery luster, and does not oxidize in the air when exposed to moisture.

Several alloys have been prepared experimentally. Copper-beryllium, which is said to resemble aluminum-copper alloy, is the one on which most work has been done. Beryllium is added to the extent of about 1½ per cent and gives a yellow alloy. The addition of 5 per cent beryllium produces a golden yellow alloy. A great deal of research work and several patented processes have been developed by French and German investigators on the production of pure metal as well as of the alloys.

RARE METALS and minerals are becoming increasingly important as new uses are found for them. Experimentation with these uncommon ores and products may be counted upon to furnish additional outlets and to stimulate the search for deposits containing them. Many readers are unfamiliar with the properties and utilization of a large number of the commodities treated in Mr. Meyer's comprehensive paper. His article is a summation of the commerce in such little known minerals and metals as beryl, spodumene, amblygonite, thallium, zirconium and many others, besides giving other useful information about them.

Compounds of beryllium which are used commercially at present are the nitrate and oxide. The nitrate is used by incandescent mantle manufacturers to harden the thorium oxide skeleton. The amount varies, some makers using as much as 5 gm. per kilogram of thorium nitrate, though others use as little as 2 gm.

The oxide has also been added to materials being used for the manufacture of abrasive compounds and in dental cements. It has likewise been recommended as a condensing agent in the preparation of certain esters. Promising results are said to have been obtained in the esterification of aliphatic acids with alcohols. The best conditions are secured when the vapors of the organic acids and alcohols are passed over beryllium oxide heated to 310 deg. C. This property may be of value to manufacturers of synthetic perfumes and essences.

Beryllium sulphate has been used in medical research and is also said to stimulate the growth of white lupin seeds, and invertase from yeast is very active in the presence of approximately 2 per cent beryllium sulphate.

The commercial ore is beryl, a beryllium-aluminum silicate, which when absolutely pure carries 57 per cent silica, 19 per cent alumina, and 14 per cent beryllium oxide. There are other beryllium minerals, but none have been found in commercial quantities. A beryl suitable for commercial purposes should carry from 10 to 12 per cent of beryllium oxide.

Beryl is found in all parts of the world, particularly in pegmatite dike areas. The most important deposits in the United States are those in the Black Hills, in South Dakota, in North Carolina, and in New Hampshire and Maine. Important deposits of the mineral have also been identified in Brazil and Madagascar.

The largest consumer of beryl apparently is the United States. The annual consumption, however, at the present time is not in excess of a few carloads per year. The ore, before it can be used commercially, has to be reduced to a very fine powder, or, in other words, ground to pass 90 to 95 per cent through a standard 200-mesh screen. It should be of a pure white color, free from ferruginous minerals and metallic iron. The price varies, according to demand and percentage of beryllium oxide, from 4 to 5c. per pound in carload lots. The chief use for ground beryl at the present time is as an addition to porcelain products, where it reduces the coefficient of expansion. It is also a source for beryllium compounds and metal. The reason that there are so few real commercial uses for beryllium metal is due to the fact that it is extremely difficult to separate it from aluminum, and partly to the fact that ores carrying a higher percentage of beryllium are not available in commercial quantities. Phenacite would be an ideal source for beryllium metal, as it carries approximately 54 per cent silica and 45 per cent beryllium oxide. Commercial deposits of this may be discovered.

Precious beryl or emerald has been known from Biblical times. It is claimed that an absolutely flawless emerald is more valuable than a diamond of the first water.

Cerium

The element cerium was first discovered in 1804 in the mineral cerite, the silicate. The element as first separated was not pure, but contained lanthanum and didymium, which elements were not discovered until about 1840.

Cerium is the most abundant of the rare-earth elements, of which there are a dozen or more. The element itself is of a silvery lustre and quite malleable and ductile. It is a fair conductor of heat but a poor conductor of electricity. It burns in the air at the comparatively low temperature of 160 deg. C., with the evolution of considerable light and heat. The light evolved is said to be more brilliant than that obtained

with magnesium. The metal when scratched with a coarse file or a sharp point throws off glowing globules. It tarnishes readily in moist air. At present there are only two commercial ores of cerium—namely, monazite and allanite. Both of these are found in abundant quantities.

Monazite in the form of sand has been produced in commercial quantities in the Carolinas, and large deposits are reported in Idaho. In later years a deposit was located near Pablo Beach, Florida, associated with zircon, ilmenite, and rutile. None of these deposits are of sufficient size to compete successfully with those of India or Brazil. The Indian deposits, located near Travancore, are exploited with cheap labor, and the sand carries an exceptionally high percentage of thorium oxide, which is the valuable constituent. It is well here to remark that monazite sand is not mined for its cerium content but for the valuable thorium it contains. Most of the Brazilian sands are of coastal origin, and although the percentage of thorium oxide rarely runs above 6 per cent, they are so easily mined that they are still able to compete with the Indian sand.

The most important deposit of allanite is located in Virginia in the Amelia County area. It is also found in Llano County, Tex., in commercial quantities. The mineral varies in composition. The general range in cerium oxide content is from about 6 per cent to more than 30 per cent. So far as is known, no real commercial quantities of allanite have ever been mined.

Cerium Obtained as a Byproduct

The great source of cerium metal and its compounds is the byproduct from the thorium nitrate factories, known as cerium residues. This byproduct is a crude cerium carbonate mixed with lanthanum and didymium. From this mixture, by electrolytic methods, is produced a crude cerium metal carrying appreciable percentages of lanthanum and didymium metals. The presence of these other elements does not seem to affect its value in commerce.

The most important use of cerium metal is the iron alloy, known as ferrocerium. This consists of approximately 30 per cent iron and 70 per cent cerium, with lanthanum and didymium metals. In this form it produces a hard, brittle alloy, which on being abraded or filed throws off showers of sparks. This pyrophoric property has made it of value for ignition devices such as cigar, cigarette, and gas lighters. Large quantities were used during the World War. The alloy is sold under various trade names, as, for example, pyrophoric alloy, spark-giving alloy, cerium alloy, sparking metal, ignition stone, fire stone and Auer metal. It is generally cast in small sticks having a diameter of from $\frac{1}{16}$ to $\frac{1}{8}$ in. These sticks are cut up into small billets about $\frac{1}{4}$ in. long, and it is in this form that the alloy appears on the market.

Other minor uses for cerium-iron alloy are in military signaling, as an illuminant in photography, for the ignition of explosives, and as reducing agents. In this latter instance the commercial cerium metal has been suggested as a valuable scavenger in metallurgical work. Cerium-magnesium alloys are claimed to form excellent flashlight powders.

No trustworthy information is available as to the annual consumption of ferrocerium or cerium residues. Small quantities of cerium nitrate are used in the incandescent mantle industry, and the oxalate is used in considerable quantities for medicinal purposes.

Other suggested applications for cerium salts are in the manufacture of cerium glass, in tanning, in photography, in dyeing, and as catalysts.

The cerium residues are sold on the basis of the cerium oxide content. It ranges from 15 to 20 per cent CeO_2. There is no established market.

Germanium

The element germanium was first discovered in 1886 in the mineral argyrodite, a silver germanium sulphide, of the following composition: silver, 74.72 per cent; germanium, 6.93 per cent; sulphur, 17.13 per cent. It is a grayish-white metal, having a specific gravity of 5.46 and a melting point around 900 deg. C. It apparently does not volatilize below 1,350 deg. C., which accounts for its presence in the lead-bearing residue from the refining of zinc. Indeed, the chief commercial source of supply is from such residues. It occurs only in minute quantities, however, and a vast amount of residue must be treated to secure even a few grams of germanium. It is also found in impure zinc oxide.

There are only two important germanium ores—argyrodite, the mineral above referred to, and a new mineral known as germanite. Argyrodite, which is found in Bolivia in commercial quantities associated with other silver ores, carries approximately 6 to 7 per cent germanium metal. Germanite occurs in South Africa and carries approximately 6 per cent germanium metal.

The chief commercial use of germanium is in the form of its dioxide. In this form it is used in medicinal preparations as a specific for pernicious anemia. It is claimed that some remarkable cures have been effected through its use. It does not have the injurious cumulative effects noted with arsenic. A new use has recently been developed for the metal in radio as a high-resistance element. It is claimed that it makes a very efficient grid-leak.

The price of germanium dioxide varies as to quantity and purity. It ranges from $5 to $10 per gram.

Lithium and Lithium Minerals

Lithium was first discovered in 1817. It is the lightest of all metals, having a silvery white lustre and readily oxidizing in the air, and decomposes water at ordinary temperatures like sodium or potassium. Its specific gravity is 0.59—so low that it readily floats on petroleum.

No important commercial uses are known for the metal itself. Its compounds, however, are largely used, the two most important of which are lithium carbonate and lithium hydrate. The carbonate is used in the preparation of artificial mineral waters and also medicinally. It sells at $1.50 to $1.60 a pound in large lots. The hydrate is a very caustic substance and is used in storage batteries of the alkaline type. It is not known definitely just how it functions, except that it greatly prolongs the life of the batteries.

There are only three important commercial ores of lithium, as follows:

Amblygonite, a lithium-aluminum fluophosphate, carries from 8 to 9 per cent of lithium oxide. This mineral is found in commercial quantities in the Black Hills district, in South Dakota, and large commercial deposits of it are also known in Australia. Commercial requirements call for a minimum of 8 per cent lithium oxide and practical freedom from detrimental impurities, as, for example, iron minerals. It is sold to the trade ground to a powder 80 to 90 per cent of which will pass through a standard 200-mesh screen. The

carload price for the ore ranges from $50 to $60 per ton at the mines. A bonus is sometimes allowed for each 1 per cent of lithium oxide in advance of the guaranteed minimum.

Spodumene—This is a lithium aluminum silicate carrying from 4 to 8 per cent of lithium oxide. Large commercial deposits of this are also found in the Black Hills area of South Dakota, as well as in the New England states, in Sweden, and in the State of Minas Geraes, Brazil. It sells for much less than amblygonite, and the price ranges from $20 to $30 per ton, depending on the lithium oxide content.

Lepidolite—This is a complex lithia mica. The lithium oxide content of this ore runs from 4 to 6 per cent. Large deposits of it are found in the Black Hills area of South Dakota, in southern California, Maine, Sweden, Germany, and Brazil. In connection with this mineral, there is offered an example of a commercial use of an ore for its physical and chemical properties alone and not for its valuable constituents. Large quantities of lepidolite are ground and consumed in the glass industry for the manufacture of certain types of special glass. The use of the mineral for this purpose is covered by patents. Lepidolite sells for about the same price as spodumene, except grades used for glass-making, which command much higher figures, owing to more exacting specifications calling for freedom from tourmaline, quartz, and other foreign minerals.

TWO OF the most important minerals discussed by Mr. Meyer are not found very plentifully in the United States, and foreign deposits furnish the bulk of the world's demands. These minerals are monazite and zircon, which are found in South America and India. The lithium minerals are found in the United States, however, especially in the Black Hills. It is also worth noting that attempts have been made to corner the supply of monazite and its important derivatives, thorium and cerium. These efforts were broken by the war.

A lithium ore which may be found in commercial quantities is triphylite or lithiophylite. This is a lithium-iron-manganese phosphate and carries as much as 9 per cent lithium oxide. Deposits of this are known to occur in South Dakota and also in the New England states. Occurrences are also known associated with spodumene in Sweden.

Thallium

The metal thallium was discovered in 1861 in flue dust from sulphuric acid plants. Physically and chemically, thallium resembles lead very closely. It has a specific gravity of 11.8 and a melting point of around 285 deg. C. It is quite soft and can be readily scratched with the finger nail. A freshly cut surface is lustrous, but rapidly becomes oxidized.

There are no known commercial ores of thallium. As indicated above, it is practically all secured from the treatment of flue dust from sulphuric acid plants, where it is found associated with tellurium and selenium. It readily forms alloys with many of the metals.

The first known use of thallium seems to be as a substitute for lead in optical glass. Thallium glass is said to have a very much higher refractive index than lead glass. Small quantities are also used in the manufacture of tungsten lamps. Recently a new use has developed for thallium in the form of its oxysulphide. This compound is used in the manufacture of a photo-electric cell, which is said to react more rapidly to varying light intensities than the selenium cell. The acetate has been used in medicine and the nitrate in the manufacture of so-called "heavy solution" or silver thallium nitrate.

The metal comes on the market practically pure, in the form of ingots and sticks. The price ranges according to quantity from $8 to $10 a pound. The total world production probably does not exceed 500 to 1,000 lb. annually.

Zirconium

The element zirconium was discovered in 1788. It is a metal which occurs in three allotropic forms—namely, amorphous, crystalline, and graphitic. In the amorphous form it occurs as a black powder, which at low temperatures burns with a bright light to the white oxide. The crystalline form has the appearance of antimony. On being heated in the air it oxidizes very slowly. The density of the pure metal is 6.4. Its melting point has been determined to be approximately 1,330 deg. C.

There are only two commercial ores of zirconium—namely, brazilite, the natural oxide of zirconium, and zircon, the silicate. Brazilite or baddeleyite is chiefly found in commercial quantities in Brazil only, at present, although it has also been identified in Montana, Ceylon, Italy, and Sweden. The analysis in per cent of a typical brazilite, or, as it is known to the trade, zirkite, is as follows: ZrO_2, 82 per cent; SiO_2, 11.38; TiO_2, 0.36; Fe_2O_3, 2.08; Al_2O_3, 0.62; H_2O, 3.35 per cent. This is a hard lump ore. Another commercial grade shows the following analysis in per cent: ZrO_2, 74.48; SiO_2, 14.08; TiO_2, 1.35; Fe_2O_3, 10.26. The Brazilian deposits are very extensive and have been ably described in "Mineral Resources of the United States," 1916, Part II (pages 377-386).

The specifications on Brazilian zirconium ore (zirkite) are rather varied, but generally speaking there are only two types of ore, a grade running 70 to 75 per cent ZrO_2 and a grade running 80 to 85 per cent. The latter is in the form of hard black pebbles known as "favas." Either grade is satisfactory for the manufacture of refractory bricks or furnace linings, but, generally speaking, the higher the zirconium oxide content, the higher the melting point. The ore is not used in lump form, but is either crushed to a coarse mesh or finely powdered and marketed as what is known as zirkite cement. This is used in laying up zirkite brick and for patching.

A Splendid Refractory

The properties of zirkite which make it acceptable for refractory use are chiefly its high melting point, low thermal conductivity, and low coefficient of expansion. It is also very resistant to slag corrosion. Bricks are made up in all standard shapes and marketed around 55c. to 75c. each in carload lots. Zirkite cement sells at 2½ to 3½c. per lb. High grades of ore, finely powdered, sell at 5c. to 7c. per lb., depending on quantity. There is no question that the uses of zirkite are

increasing greatly, but like all new refractories it is difficult to overcome prejudices, particularly in view of the fact that it is much more expensive than the common refractory material formerly in use.

The other ore of zirconium, zircon, or the silicate, is found in commercial quantities in North Carolina, Florida, Brazil, Ceylon, and Scandinavia. The principal commercial deposits are those of Florida and Brazil. In both places it is produced through electromagnetic concentration of beach sands. In Brazil it is a byproduct in the concentration of monazite sand. In Florida it is more or less of a byproduct in the concentration of ilmenite. A typical analysis of Brazilian zircon sand in per cent is as follows: zirconium oxide, 57 per cent; silica, 30 per cent; titanium oxide, 8 per cent; alumina, 8 per cent; cerium and yttrium earths, 3 per cent. Zircon sand ranges in price from 3½ to 5c. per lb., depending on quantity. It is sold both in the form of sand as well as ground to a fine powder. As a source for the zirconium salts and purified oxide, zirkite is preferred to zircon, as it is more amenable to chemical treatment. It also has proved superior to zircon for refractory purposes. Recently an electrically sintered zirkite has been placed on the market, and it is thought that it will prove of value in certain cases where a substance free from fire shrinkage is required.

No real commercial use has yet been developed for the metal. It has only been prepared on a laboratory scale and is rather difficult to manufacture. During the war a great deal of development work took place in connection with ferrozirconium, and a considerable quantity of the alloy was manufactured. Owing to the high percentage of silicon present, it was impossible to determine whether the results secured were due to zirconium or silicon.

There are several commercial grades of ferrozirconium on the market, as follows: A true ferrozirconium analyzes approximately as follows: zirconium, 35 to 40 per cent; silicon, 16 to 18 per cent; aluminum, 3 to 4 per cent. Silicon zirconium contains 30 to 35 per cent zirconium, 40 to 50 per cent silicon, and the remainder largely iron. Zirconium ferrosilicon contains 8 to 10 per cent zirconium, 70 to 75 per cent silicon, and the remainder largely iron. Some of the above are used for hardening purposes and others as scavengers or deoxidizers and function in much the same way as does ferrotitanium.

Ferrozirconium and other zirconium alloys are sold on the basis of the zirconium metal content. The price varies anywhere from $3.50 a pound of contained zirconium metal to as low as 6 to 8c. a pound of contained zirconium present in the zirconium ferrosilicon.

Oxide Sold in Several Forms

By far the most extensive use of zirconium is in the form of its oxide. This appears on the market in the form of the natural oxide, known as zirkite, and technically pure or chemically pure oxides derived from the native oxide. The most important use for the oxide is as a refractory body. The linear coefficient of expansion of pure fused zirconium oxide is 0.00000084. This makes it very close to that of fused silica, and if it were possible to produce articles from the pure fused oxide, they would no doubt find extended commercial uses.

The commercial oxide of zirkite is made into a variety of forms, as, for example, crucibles, muffles, combustion tubes, and resistance cores. It must always be borne in mind, however, that the material has a very low thermal conductivity. Hence the walls of the crucibles or other shapes must be considerably thinner than if other refractory bodies were used if it is desired to apply the heat externally. In the manufacture of bricks no binder is used, the body consisting of about 40 per cent of coarsely crushed calcined zirkite, the remainder being zirkite cement. This on being burnt yields a hard brick. Such binders as sodium silicate, lime, phosphoric acid, and fireclay have not proved satisfactory. The melting point of pure zirconium oxide has been variously reported as being 2,563, 2,700, and 2,950 deg. C.

The total consumption of zirconium ore is comparatively small and probably does not exceed fifty to a hundred tons annually. The consumption of the technically pure and pure oxides in all probability does not run over four to five tons per annum. The chemically pure oxide sells at 60 to 75c. per lb., depending on quantity. A semi-refined grade carrying from 90 to 95 per cent zirconium dioxide sells at from 8 to 12c. per lb.

A commercial use for the refined oxide which bids fair to be of some importance is as a substitute for tin oxide in the enameling industry. Here it is used as an opacifier to produce the white glazes used on cooking utensils and other articles of a like nature. Over and above its opacifying properties it is claimed to impart properties to the finished ware which make it a highly desirable addition to the enamel mixture. It is not improbable that it will ultimately replace tin oxide entirely for such purposes.

Minor uses for zirconium compounds are as an addition to fused silica ware to prevent devitrification and increase the tensile strength, and the use of the carbide for filaments in incandescent lamps. The carbide has also been suggested as an abrasive body, owing to its hardness, which is about that of topaz. The uses of the oxide, silicate, carbonate, and phosphate have all been patented as pigments. They are claimed to have high covering power and are non-poisonous. The basic acetate has been used for weighting silk. The pure oxide has also been used as a substitute for bismuth subnitrate in the making of X-ray photographs.

Hafnium

It seems entirely proper to mention under zirconium the new element hafnium, which was discovered recently by Coster and Hevesy. This new element, which has some very interesting properties, is present in all zirconium minerals in appreciable amounts, ranging from 2 to 20 per cent. It is likewise present in so-called commercially pure zirconium oxide and salts of zirconium. It can be readily separated from the rare-earth elements, and resembles zirconium very closely in its chemical properties. It has a very high melting point and high power of light emission. The electron emission of the heated metal is very high, which suggests that possibly it would be of value in vacuum tubes for radio purposes. The element is abundant enough to make it available for commercial purposes.

Thorium

The element thorium was first discovered in the form of its oxide in 1828. The mineral in which it was first identified was subsequently named thorite and is a silicate of thorium. Thorium metal has a specific

gravity of 11 and a melting point around 1,700 deg. C. It is not affected by atmospheric conditions up to temperatures of 100 deg. C., but on heating in the air to higher temperatures ignites and burns with a brilliant light, producing the oxide which is commonly called thoria.

The metal itself has a limited but important application in the incandescent lamp industry as well as in the manufacture of filaments for the three electrode vacuum tubes used in radiotelephony. In the case of the incandescent lamp, it is added to the tungsten filament to the extent of 1 per cent to increase the ductility of the metal. In filaments for vacuum tubes in radio work, it is added to increase the electron emission of the filament when heated.

Chief Source Monazite Sand

The chief source of thorium is monazite sand, which is mined in the form of an alluvial sand, the principal deposits being those of India and Brazil. There are undoubtedly deposits of economic importance in the United States, but those already known unfortunately have been unable to compete with the foreign deposits, owing to high labor costs. Most monazite sand deposits have been produced by the natural concentration of the disintegration products of igneous rocks, chiefly granites and their derived gneisses. This natural concentration is excellently illustrated in the coastal deposits of Brazil, where the sand is classified on the beaches by wave action. The separation of the monazite from the associated minerals, which are chiefly zircon, ilmenite, garnet, and quartz, is effected through the difference in specific gravity and magnetic permeability.

The percentage of monazite in Brazilian deposits varies widely in different sections. In some instances it is as low as 2 per cent and in others as high as 60 per cent. The Indian sand, which is found chiefly in Travancore, carries a very much higher percentage of thorium oxide than the Brazilian. The standard Brazilian sand carries a minimum of 6 per cent, whereas the standard Indian sand carries a minimum of 8 per cent, actual analyses sometimes showing as high as 10 per cent.

Brazilian Monazite Formerly Exploited by Germans

The commercial development of Brazilian monazite sand was first begun by an American. In the early days the product was exported to Germany as ballast at a cost of less than $15 per ton. Large profits were realized, as the value of a sand carrying from 5 to 6 per cent thoria was from $100 to $125 per ton. In 1903 the Brazilian Government forbade the further exportation of the sand and declared the deposits government property. Later the government requested bids from all those who desired the privilege of working these deposits and the rights were secured by a large German corporation. This company guaranteed the Brazilian Government a royalty of 50 per cent on the sales made on a minimum production of about 16,000 tons. Later there was a merging of interests, with the understanding that the whole annual production was to be sold to the German Thorium Syndicate, which at that time was endeavoring to control the price of thorium nitrate throughout the world. The syndicate agreed to pay those having the government concessions, in addition to a fair selling price, a share of the profits which it made on the sale of thorium nitrate.

The discovery and development of the Indian deposits resulted in a price war, and the German syndicate, having large interests at stake, cut the price of thorium nitrate 50 per cent and limited the quantity sold to any one customer. This limiting of quantities sold was to prevent speculation and the acquisition by brokers of large stocks of low-priced nitrate. Through this policy the mining of monazite in the Carolinas, which prior to 1906 had been flourishing, was definitely abandoned. After thus eliminating annoying competition, the syndicate slowly advanced the price of the nitrate until it nearly reached its former level as noted in a preceding paragraph.

The commercial demand for thorium nitrate is in the manufacture of incandescent gas mantles. The first patent on the manufacture of such mantles was granted Welsbach in 1894, but the commercial success of the industry cannot be said to have been assured prior to 1913. It is interesting to note the effect the rapid growth of the industry had upon the price of the nitrate. Prior to 1893, thorium nitrate was considered one of the very rare chemical compounds and sold for over $200 a pound. As the demand for incandescent mantles increased, the price dropped very sharply, and in 1914 it had declined to the low level of $2.71 a pound.

It was estimated in 1918 that the world's consumption of monazite was approximately 3,000 tons per annum. At present the American consumption has practically dropped to zero. Many of the mantle plants have ceased to manufacture the nitrate on any large scale except in sufficient quantities to take care of their rapidly dwindling trade. Some plants have turned their attention to the manufacture of other articles and are utilizing the elaborate chemical installation for the production of different chemical compounds.

Reserves Available

United States Government reports estimate that the lands along the seacoast of Brazil may yield from 15,000 to 20,000 tons of pure monazite and the interior deposits would probably yield around 18,000,000 tons of monazite-bearing gravel which should produce about 4½ per cent of thorium oxide. The amount of pure monazite in the Carolinas is estimated at 15,000 to 20,000 tons. No data are available as to the extent of the Indian deposits.

There are two other thorium minerals which have been mined in commercial quantities—thorianite and thorite. The former ore is obtained from the gem washings in the Island of Ceylon. It carries from 50 to 75 per cent of thorium oxide. Thorite is found in very much smaller quantities, and it is highly improbable that either of these minerals will become commercial rivals of monazite sand.

Judging from developments in the use of the metal cerium, it is quite probable that the chief demand for monazite in the future will be for its cerium content and not for the thorium, which is really present as an impurity. Pure crystallized monazite carries little or no thorium oxide.

Brazilian monazite sand sells for 5 to 8c. a pound of sand, based on a minimum of 6 per cent thorium oxide. The Indian sand sells at several cents a pound more. Monazite sand is duty free, but thorium nitrate under the present United States tariff carries a duty of 35 per cent *ad valorem*.

Status of the Shale-oil Industry

Résumé of World Conditions and Progress in Technology

By G. W. Wallace
Consulting Engineer, 1340 Mission St., San Francisco

G. W. Wallace

HAVING recently returned from a survey of the oil-shale situation in Europe, the following comments may be of interest to those in America who are keeping in touch with the development of the industry:

In England there are few known deposits of commercial importance. A great deal of attention has been drawn recently to the shales near Watchet, Somerset, in connection with which W. B. Hume has compiled a report, based largely on optical observation. The conclusions reached indicate how easy it is to place an exaggerated valuation on a shale property; they emphasize the care that should precede commercial exploitation. A summary of this report on the Lower Triassic shales of Somerset follows:

"This report does not deal with the commercial value of the deposit, but discusses the subject solely from the geological point of view. It was found on inquiry that but little recent work had been done, except possibly of a private nature, the records of which are not available.

"The lower Lias is exposed along the coast of Somerset on each side of the Quantock Hills. In this stretch the following divisions have been recognized:

"*E*—40 to 45 deg. Shaly marls with thin clayey limestone and paper shales near the base.

"*D*—20 to 25 deg. Alternations of gray limestone with shales and shaly marls verging into blue limestones. Seen east of Kilve and west of Quantock Head.

"*C*—40 deg. Alternations of blue and yellow limestones with blue and brown marly shales.

"*B*—30 to 35 deg. Dark-gray shale and gray marl, with occasional limestone.

"*A*—20 deg. Shaly marls, dark shales, and limestone.

"From the statements issued by the discoverers it would appear that they consider the whole series to contain oil shales. They even refer to oil shales of the Triassic beds below, although these are not taken into consideration in their figures. It seems more probable that the series *D* and possible the base of *E* contain the oil-bearing horizons.

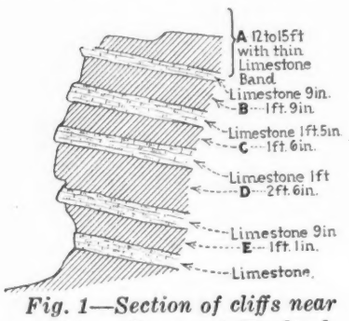


Fig. 1—Section of cliffs near Kilve, Somerset, England

"The cliffs at Kilve, where work is being performed, belong to Group *D*. Fig. 1 represents a section of these, immediately east of the road from Kilve, from whence samples *B*, *C*, *D*, and *E* were taken. The beds all dip inland and slightly east, so that lower horizons disappear gradually eastward, and higher beds become available. The full thickness of bed *A* is seen around the next headland and shows 12 to 15 ft. of shale, with a thin limestone bed. Samples of *A* were taken at this point.

"Fig. 2 shows the section along the coast. From this it will be seen that the beds are much faulted, and that Rhaetic and Keuper beds are continually being brought to the surface. Fig. 3 shows a section further inland and parallel to the coast; it illustrates the complicated structure occurring on each side of the Quantock Hills. Fig. 4 is a rough sketch map of the area, taken from the published map of the Geological Survey, which is far from complete. Many faults are indicated, but they have not been followed, and many more have been indicated in recent work in the Quantock Hills. Unfortunately, interest has centered in the older rocks of the hills, rather than in the Liassic shales and limestones.

"Attention is drawn to the series of faults shown in the eastern part of the map and to the eastern end of the section in Fig. 3; these are continually bringing the same beds to surface. With so many faults it becomes impossible without careful investigation to foretell with any approach to accuracy how much of any particular bed in the series may be present in the series. Beds occupying higher parts in the series would in the natural course of erosion be more completely removed that those lower in the sequence, and the beds of Series *D* would probably be found to be absent form about two-thirds of the basin.

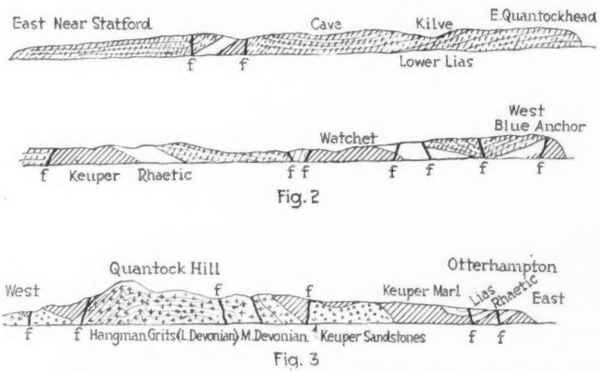


Fig. 2—Section of coast in the shale region in northern Somerset

Fig. 3—Inland section across Quantock Hills

"Assuming regular erosion and regular bedding, the percentage of areas in which any horizon may be present can be roughly calculated. The areas of the two lower Lias basins east and west of the Quantock Hills are about 13 and 1.8 square miles, respectively; so that the area under which the *D* beds might occur would be: East 4.4 square miles; west 0.6 square mile; total, 5 square miles. In Bed *D*, Fig. 1, the percentage composition is approximately as follows: Shales and marly shales, 80 per cent; limestone, 20 per cent.

"It is possible that the limestones thicken in other parts, but as this has not been ascertained it will be assumed that the above percentage holds good. The thickness of the bed has been quoted as varying from 20 to 25 ft., and the latter figure is also assumed here as the general thickness. Thus, there should be 20 ft. of shale over an area of 5 square miles, interspaced with a total of 5 ft. of limestone. The depth is not likely to be much more than 50 to 60 ft.; 60 per cent of this may be considered available, or a little over 60,000,000 cu.yd. There are, however, too many unknown factors for this to be advanced as a definite conclusion."

Shale of economic value in Scotland is nearly exhausted. This is due to the depth of the workings and the increasing cost of mining. The Scottish shale industry has been supported largely by the profit derived from the sale of byproducts, principally sulphate of ammonia. With so many coke ovens going into operation, producing sulphate at low cost, the profit from byproduct realization in the Scottish shale industry has been greatly reduced. In addition, the yield of oil and ammonia has decreased considerably as the deposits have been worked to greater depths.

A moderate amount of torbenite is known to exist in England. The deposits are principally found associated with coal, and should ultimately be a source of profitable production of crude oil in England. Some torbenite yields as much as 60 to 80 gal. of oil per ton; however, it is found in thin beds, and unless mined in conjunction with coal could hardly be worked at a profit.

In France there are several well-known shale deposits, the most important of which is in the Autumois Basin, which covers about 60,000 acres, under which the shale is found in several beds, supported by a varying depth of known oil-bearing structure. The beds dip abruptly, and it is estimated that the principal seam, which is about 9 ft. thick and yields about 23 gal. of oil per ton, contains 150,000,000 tons of shale which can be commercially exploited. The French shales are in reliable hands, and considerable interest is being shown in the possibility of immediate development.

Several deposits of shale in Spain offer possibilities,

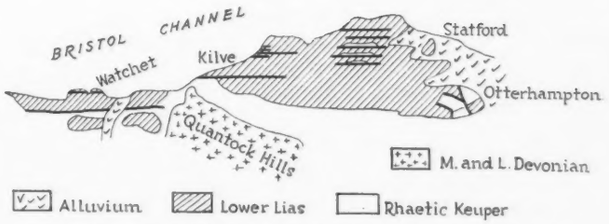
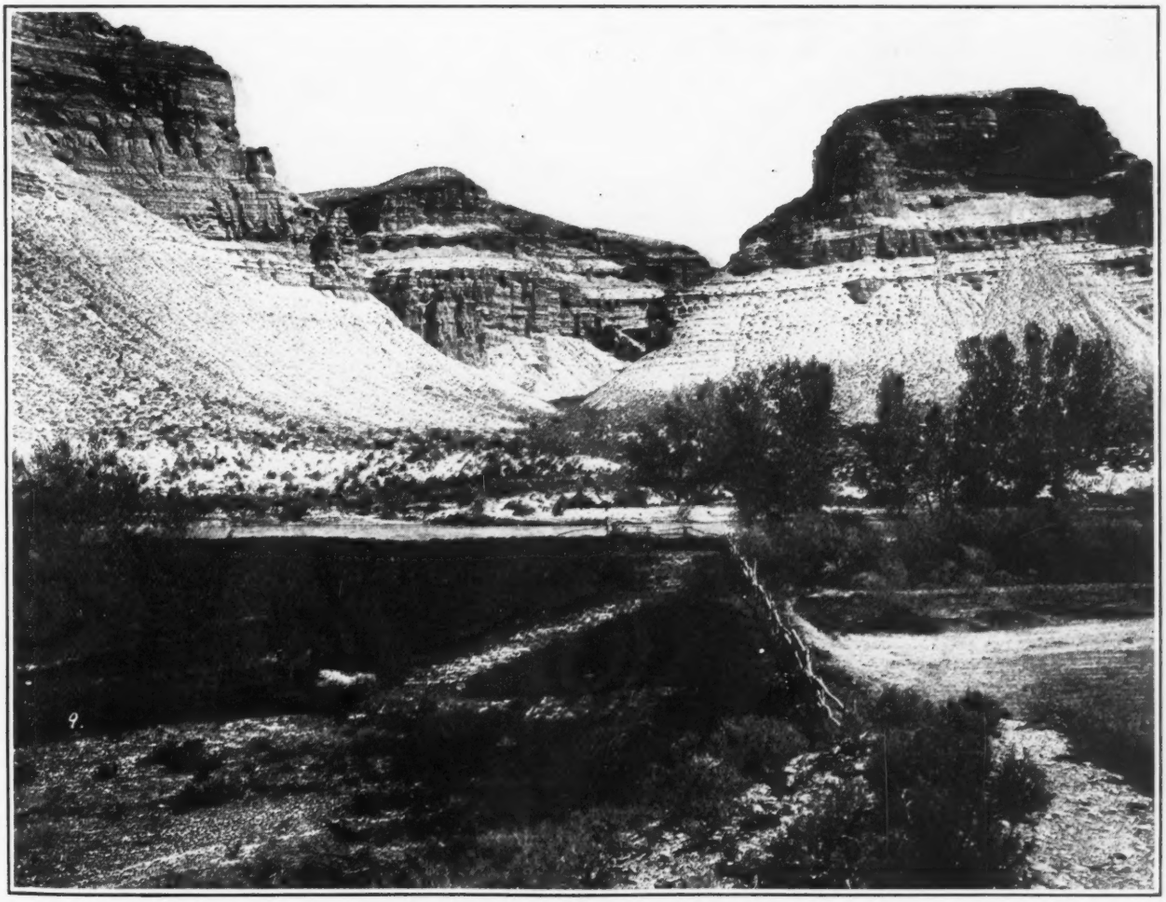


Fig. 4—Sketch map of Somerset shale area

due to the high import tax on petroleum commodities entering that country. Interest is being shown in England in these deposits, and the indications are that they will soon be exploited. The principal area is near the Port of Castellon, in the province of the same name; it extends about 1½ miles and varies from ¼ to 1¼ miles in width. The oil yield is about 20 gal. per ton. A second important deposit is about 150 miles from the coast, on the Mijares River, although not considered as important as the one near Castellon.

Esthonia Deposits of Shale Attract Attention

The greatest interest shown in European shales is in connection with the deposits in Esthonia, which are extensive. The shale is rich in oil, but difficulty in exploiting has been experienced because it does not lend itself to the known methods of retorting, principally because when heated it softens and tends to form an impervious mass in the retort. Experimental work now being conducted promises good results, and it is probable that in the near future Esthonia will produce a considerable quantity of crude shale oil.



Shale deposit in Uintah Basin, Utah

The shale areas of Esthonia cover approximately 772 square miles. The government is mining shale for use as fuel in the cement works and on the railroads, and in the manufacture of gas. A small quantity is consumed in the production of oil. In 1923, more than 200,000 tons was mined and sold. It is encouraging to note that the development of the Esthonian shales is being attempted by competent English financiers under the guidance of qualified engineers. Cunningham Craig has devoted considerable time and attention to the project, and has reported extensively on its possibilities; it is reasonable to expect ultimate success.

Although important deposits of shale exist in South Africa, the reports of engineers indicate that, like the English shales, the beds are too thin for profitable exploitation unless worked in conjunction with the mining of coal.

A great deal of interest is being exhibited in the development of the Australian shales, which are extremely rich so far as oil is concerned; but difficulty has been encountered in retorting, in consequence of a tendency to fuse and stick in the retorts. The type of plant used in Scotland has been tried in Australia, but without success, because of this reason. However, it is believed that recent developments in the recovery of oil from shale will obviate the trouble and make it possible to recover the oil at a substantial profit. The development of the Australian shales will probably be carried out largely by Australian and English interests.

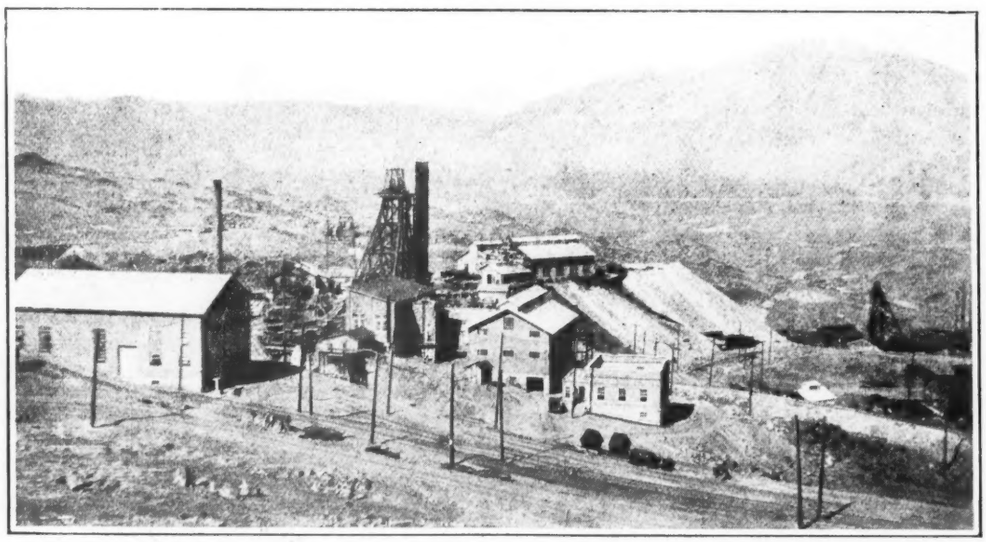
In Canada, well-known deposits have occupied public interest from time to time, more particularly those in New Brunswick and Nova Scotia, where shales cover vast areas and in the aggregate will probably amount to several billion tons. Unfortunately, the deposits are badly folded and separated by intrusions, which necessitates many separate entries in mining. As illustrating the interest being shown in the New Brunswick shales, the Anglo-Persian Oil Co. recently conducted an exhaustive research to determine the potential value of the deposits and the character of the oils from a refining standpoint. The results of this investigation indicate that New Brunswick has a large oil reserve, which, under experienced direction, will eventually be exploited.

In the United States, the possibility of shale-oil exploitation on a large scale has been given considerable attention for many years. The deposits in the Uintah Basin, in Colorado and Utah, represent a potential oil reserve of great value. The extent of the interest being shown at the present time is indicated by the fact that some of the large oil companies have acquired property holdings of considerable magnitude. Shale is also known to exist in many of the Eastern states, as well as in Nevada, California, and other Western states. Continued effort is being made to develop these shales. Numerous companies have erected small plants, some of which have attained a degree of success. The encouraging feature, however, is that technical knowledge of the subject is increasing. With the gradual depletion of the underground reserves of liquid oil, it is merely a matter of time until the development of the oil shales in the United States will be an economic necessity.

The cost of mining and preparing shale for retorting is probably the most important factor in the cost of producing crude shale oil. However, suitable retorting methods must be adopted, and the cost of producing the oil must be reasonably low. The capital charges involved in the erection of the plant must be moderate, otherwise the fixed charges entering into production costs might make operation unprofitable. Qualified engineers are working on the problem, and it is encouraging to note that they are securing results which indicate that shale oil can be produced, all costs paid, at a figure which it is expected will soon permit competition with ground oil.

Although shale oil fills many purposes, it is recognized that the development of the industry necessitates study and research on many problems in refining and the development of a technic that will differ materially from that which characterizes operations in the petroleum industry.

A Modern Surface Plant in Butte



Senator Clark's Elm Orlu mine, which has produced a variety of minerals, ranging from manganese to copper. The Black Rock mine, of Butte & Superior, can be seen at the right background

Determination of Lead, Copper, and Tin in Drosses

By John H. Hastings
Chemist, Donora, Pa.

IN THE FOLLOWING brief paper I have described some methods of analyzing drosses for lead, copper, and tin, which may prove of interest to assayers and metallurgists.

The material is sampled in the car, as it is being unloaded, by taking one shovelful out of ten, and half shoveling and quartering this down from 5 to 10 lb., breaking and cutting up the lumps with the shovel. The sample is then dried, and is further prepared by putting 2 or 3 lb. through an 80-mesh screen, and, if there are coarse metallics, they are separated with a 4-mesh screen. Sometimes these metallics are melted and the bar is sawed or drilled. This method is not as accurate, however, as the oxidized material coating the metallics is not correctly accounted for unless the slag is retained, which increases the number of samples. If a coffee mill type of grinder is used, the metallics are generally ground finer than 4 mesh. Metallic iron is removed with a magnet and weighed as a separate portion.

Lead in Lead Dross

In determining lead in lead dross, 0.25 gm. of the fines is weighed in duplicate into 250-cc. beakers; 10 cc. of nitric acid and 5 cc. of hydrochloric acid are added. After heating on the hot plate to dissolve the dross, the solution is cooled and 15 cc. of sulphuric acid added. The solution is fumed for one hour, or until copious fumes of sulphuric anhydride are evolved, over a fairly hot flame. After cooling 100 cc. of cold water is added and the solution heated to boiling, cooled, and filtered through a close filter. The precipitate is washed three times and the beaker washed out with cold water. Care must be taken to use the same quantity of water in washing as is used on the standard, as the lead sulphate is slightly soluble in cold water. Fifteen cubic centimeters of a saturated solution of ammonium acetate is placed in the beaker and the precipitate washed into it from the paper, and the paper dropped in; 100 c.c. of water is added, and the solution brought to a boil. It is titrated with ammonium molybdate, using tannic acid as an indicator. The end point of the determination is the first change to a faint yellow color.

Five grams of the metallic portion is weighed into a 500-cc. beaker and 50 cc. of water and 50 cc. of nitric acid are added. The beaker is placed on the hot plate and heated until the lead is in solution. It is then cooled and made up to 500 cc. with cold water, 25 cc. pipetted into a 250-cc. beaker, and 15 cc. of sulphuric acid added. The procedure from this point is the same as for the fines.

Of the solutions used, the ammonium molybdate solution contains 4.25 gm. to a liter of water. The tannic acid solution contains from 0.1 gm. to 20 cc. of water.

For standardizing, 0.2 gm. of c.p. sheet lead is weighed in triplicate into 250-cc. beakers; 10 cc. of water and 10 cc. of nitric acid are added, and the beaker is heated gently until the lead is dissolved. Fifteen cubic centimeters of sulphuric acid is added, and the procedure continued exactly as for dross. One cubic centimeter of the solution of ammonium molybdate equals approximately 5 mg. of lead.

Copper in Copper Dross Containing Tin

Copper in copper dross containing a low percentage of tin is analyzed as follows:

A quarter gram of the fines is weighed out in duplicate into 250-cc. beakers and 5 gm. of the metallics into 500-cc. beakers. Five grams of potassium chlorate and 10 cc. of nitric acid are added to the fines. The metallics are dissolved in 50 cc. of water and 50 cc. of nitric acid, the solution made up to 500 cc., and 25 cc. is pipetted into a 250-cc. beaker, and 5 gm. of potassium chlorate and 10 cc. of nitric acid added. The procedure is the same henceforth for both fines and the metallic portions. The solution is run to dryness and heated for one hour or longer, to oxidize any tin present and to drive off all nitric acid. Avoid overheating or fusing. After cooling, 10 cc. of water and 25 cc. of ammonia are added and the solution is heated for several minutes at the boiling point. It it filtered through a close filter into a 250-cc. copper flask. Wash once with ammonia and then three times with cold water.

The beaker is placed under the funnel and 5 cc. of hot one-to-one nitric acid run through the filter to dissolve any copper contained in the tin. The paper is washed twice with hot water and a pinch of potassium chlorate added to the acid filtrate. The beaker is heated to complete dryness as for the first solution. Five cubic centimeters of water and 5 cc. of ammonia are added and heated gently and then filtered through a clean filter paper, into the copper flask. The paper is washed once with ammonia and two or three times with cold water.

The flask is placed on the hot plate and heated near the boiling point until the ammonia is expelled. Then 5 cc. of strong acetic acid is added and the solution again brought to a boil. This is a modification of the short method for copper found in Low's "Technical Methods of Ore Analysis," 1913 edition.

The solution is cooled and titrated at a volume of 40 cc. with standard sodium thiosulphate, after adding 6 cc. of a 50 per cent potassium iodide solution. After the brown color has nearly faded, 5 cc. of fresh starch solution is added and the titration finished, the end point being when the blue color just disappears. The method can be used with entire safety with tin up to 10 per cent.

The sodium thiosulphate solution used contains 19.5 gm. of the salt to a liter of water. The potassium iodide solution contains one part by weight to two parts of water. Six cubic centimeters is equivalent to 3 gm. of the solid.

The starch solution is made by mixing 1 gm. of potato starch with a little cold water, then making up to 200 cc. with hot water and boiling a few minutes, then cooling.

In standardizing, 0.2 gm. of c.p. copper foil is weighed in triplicate into 250-cc. copper flasks. After

wetting down with a few cubic centimeters of water, 5 cc. of nitric acid is added and heated until the brown fumes are given off and the copper is dissolved. Then 40 cc. of water is added and the solution made alkaline with ammonia. It is then heated until the excess ammonia is expelled. Five cubic centimeters of strong acetic acid is added and the solution brought to a boil and cooled. The titration is conducted as for the dross. One cubic centimeter of the sodium thiosulphate solution equals approximately 5 mg. of copper.

Tin and Copper in Tin Dross

Five grams of the fines as well as 5 gm. of the metallics are weighed in duplicate into 500-cc. beakers. Then 50 cc. of one-to-one nitric acid is added, and the solution boiled until the brown fumes disappear. The solution is then made up to 150 cc. with water and heated to near the boiling point for a half hour. It is filtered through two No. 589 S. & S. 12½-cm. diameter filter papers. The tin is contained in an oxidized condition on the paper. It is best to wash by decantation once or twice with hot one-to-six nitric acid. Then the paper is washed three times with the same acid and once with hot water.

The filtrate is evaporated to dryness after adding 5 gm. of potassium chlorate, best on a steam bath over night, and then heated one hour or longer to oxidize any tin. Then 10 cc. of water and 25 cc. of ammonia are added. It is heated until the copper is dissolved, then filtered through a fresh filter paper into a 250-cc. flask. The paper is washed once with ammonia and three times with cold water. The beaker is placed under the funnel and 5 cc. of hot one-to-one nitric acid run over the paper. It is then washed twice with hot water and a pinch of potassium chlorate added to the beaker. The filtrate is run to dryness, as before, and taken up with 5 cc. of ammonia and 5 cc. of water. After heating to dissolve the copper, the solution is filtered through a fresh paper into the 250-cc. flask containing the rest of the copper. The paper is washed once with ammonia and three times with cold water. The determination is then continued for copper in the manner described in a preceding paragraph for copper dross.

The papers containing the tin from the second and third filtrations are put with the first. The oxidized tin is removed from the papers, and the papers are placed in a No. 2 clay crucible and ignited at a low red heat. The tin, after drying, is added to the crucible and ignited.

The crucible and contents are cooled in a desiccator and the tin oxide is weighed. The tin oxide is ground in an agate mortar, and an aliquot portion of the fines and metallics is weighed in duplicate, so that each represents 0.25 gm. of the original sample. That is, one-twentieth of the weight of the ignited fines multiplied by the percentage of fines in the original sample is added to one-twentieth of the weight of the ignited metallic portion, multiplied by the per cent of the metallics.

The weighings are placed in a 60-cc. iron crucible to which have been added 5 gm. of sodium peroxide. The covered crucible is placed over a low flame at first and then fused for ten minutes over the full flame of a Bunsen burner. The crucible is then cooled and placed with the cover in a 400-cc. beaker. The crucible is carefully filled with cold water from a bottle, the beaker being kept covered. It is then placed on a hot plate and brought to a boil. The crucible is removed, washed out into the beaker with hot water, and a little hydrochloric acid added until the solution is acid. This requires about 15 cc. The crucible cover having been removed, 50 cc. of hydrochloric acid is added and the solution made up to 200 cc. The solution should not contain more than one-third its volume of hydrochloric acid nor less than one-fourth. The solution is transferred to a 250-cc. Erlenmeyer flask.

A bent tenpenny iron nail or iron chain is placed in the bottom of the flask, and two or three straight tenpenny nails are stood up against the side of the flask. A Craig guard tube[1] is placed on the flask. This apparatus consists of a rubber stopper with a glass tube bent down at 45 deg. to within a half inch of the bottom of the flask, and then bent up an inch with a pin hole at the bottom of the second bend. The solution is heated to 80 deg. C. for one hour after the iron is reduced. Care must be taken that the ebullition is not too vigorous at first, or some tin will be carried over and lost. When the reduction is finished, a piece of rubber tubing closed at one end is placed over the end of the glass tube and the bend place in a 250-cc. beaker containing a half inch of strong sodium bicarbonate solution made from boiled water free from oxygen. The flask is then cooled to room temperature in cold water. As the flask cools, some of the bicarbonate solution is drawn into the flask, which, on striking the acid, generates sufficient carbon dioxide to fill the flask and prevent subsequent oxidation by contact with air.

When cool, the nails are removed and washed with sodium bicarbonate solution and 5 cc. of starch solution added and the tin titrated with iodine. A permanent blue color is the end point.

The iodine solution used contains 11 gm. of iodine dissolved in about 50 cc. of water containing 20 gm. of potassium iodide and made up to one liter. The starch solution is made the same as for the copper determination. The sodium bicarbonate is a 10 per cent solution.

In standardizing, 0.150 gm. of arsenious acid is weighed in triplicate into 250-cc. beakers. It is dissolved with a gram of sodium hydroxide and a few cubic centimeters of water; then 100 cc. of water is added and a little phenolphthalein indicator. It is neutralized with hydrochloric acid and a drop added in excess. Two or three grams of sodium bicarbonate are added, and the solution is cooled. It is titrated with the standard iodine solution after adding 5 cc. of starch solution. One cubic centimeter of the iodine solution has a value of approximately 5 mg. of tin; 0.150 gm. of arsenious acid is equal to 0.1806 gm. of tin.

Two-tenths of a gram of chemically pure tin metal may be weighed in duplicate into 250-cc. Erlenmeyer flasks and dissolved with 50 cc. of hydrochloric acid and made up to 200 cc. with water; then reduced and titrated with the dross determination in the same manner, as a check on the reductions. This method avoids the disagreeable features of the cyanide fusion and saves time in avoiding the long hydrogen sulphide separation.

Copper interferes in the tin determination, involving titration with iodine, and tin interferes in the iodide method with copper if not removed, at least if the copper is present in the tin determination in excess of 2 or 3 per cent.

[1] *Engineering and Mining Journal*, July 6, 1918. Vol. 106, No. 1, p. 25.

A Glacially Transported Mine

An Interesting Geological Freak Occasionally Found in Mining

By R. T. Walker

R. T. Walker

"FLOAT"—the prospector's term for vagrant, detached fragments of the outcrop of an orebody—varies in size from the pin-point particles of gold, that have betrayed the location of many hidden veins, up to boulders of many tons' weight. Though the chief role of "float" has been to arrest the attention of the prospector and to guide him to its place of origin, instances are numerous where the "float" itself has been sufficient in value and amount to repay gathering, and sometimes it has proved of greater intrinsic worth than the orebody from which it originated.

Occasionally there are found what may be termed "float mines," by which is meant rock masses of large size, containing sections of veins or orebodies that have been dislodged from their original positions by landslides and other surficial agencies, as distinguished from the subterranean partition of veins into separated fault segments by earth movements of profounder origin. Of such "float mines," for instance, was the "Puzzle Mine," in the Rico district of southwes'ern Colorado[1], where what appeared at first sight to be simply a knoll of limestone protruding from a creek bank proved, on exploration of the vein that traversed it, to be an isolated limestone mass of considerable size underlaid and surrounded by stream gravels.

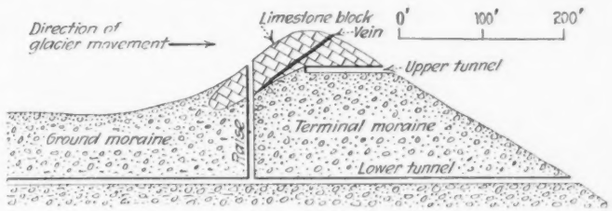
Other "Floating" Mines

The richness of the ore that this block of limestone yielded—reported to have amounted to $200,000 in gross value—stimulated search for its original position; and although it was possible to correlate the limestone with strata several hundred feet higher up on the hillside above, the continuation of the vein was never identified with certainty, so far as I am aware.

In the Absoraka range of southern Montana the small mining camp of Cooke City lies in a deep glaciated valley, the west wall of which, weakened by glacial sapping, has collapsed for a distance of about a mile. One of the landslide blocks of large dimensions that occur in this area is traversed by a vein of silver-lead ore, which, on being followed downward from the surface, was found to terminate at a shallow depth in a chaotic mass of landslide rubble. Of a similar nature was the Currency mine, situated between Telluride and Ophir, in southwestern Colorado[2]; and doubtless many other instances of the same character could be accumulated.

The purpose of this article is to describe a "float mine" which is of rather unusual character, in that it owes its separation from the parent orebody not to the customary agency of a landslide but to glacial transportation.

In the eastern part of the State of Idaho rises the Lemhi range, an elongated elevated fault block of typical "Great Basin range" structure, which attains an altitude of nearly a mile above the broad structural valleys that border it on either side. During the Glacial Epoch some of the stream canyons that dissect this range were occupied by small alpine glaciers, as is evidenced by their U-shaped cross-section, the well-developed cirques at their heads, and the cresentic terminal moraines that barricade their mouths. On the eastern slope of the range, two miles north of the mining camp of Gilmore, is a small valley locally known as Texas Gulch, which was tenanted by a glacier during this period. The glacier was small, as the distance from the cirque at the head of the valley to the terminal moraine is barely two miles. At the summit of the center of this terminal moraine, which here rises some 250 ft. above the valley floor, there was discovered some years ago a vein of oxidized silver-lead ore inclosed between limestone walls, which was located and worked under the name of the "Little Hill" mine. After the portions of the orebody readily accessible from the surface had been worked out and several hundred tons of ore had been shipped, the owners of the property started a tunnel at a point on the outer face of the terminal moraine about 175 ft. below the crest, for the purpose of developing the vein at this depth.



Cross-section of the glacially transported mine

The tunnel was driven for a distance of 700 ft., passing beneath and beyond the surface exposures, without encountering solid rock of any description or any evidence of a vein, the entire distance being in unconsolidated glacial debris, consisting of subangular boulders, principally of quartzite, embedded in a matrix of smaller rock fragments and of clay. From a point in the tunnel immediately below the surface outcrop there was then put up a raise, which, after passing through about a hundred feet of the same unstratified glacial debris as had been found in the tunnel, encountered limestone, in which it continued to the surface. Subsequently, another tunnel was driven from

[1]U. S. Geol. Surv. 21st Ann. Rept., Part II, p. 134, "Geology of the Rico Mountains, Colorado."

[2]U. S. Geol. Surv., Telluride Geologic Folio, p. 11.

the outer face of the terminal moraine at a point about 125 ft. above the lower tunnel. This new tunnel struck and followed the contact between the limestone and the underlying morainal material, the contact proving to be nearly horizontal.

Carried by Glaciers

If it were not for the known circumstances previously described, the most plausible explanation for the occurrence of the vein outcrop in limestone in the middle of the crest of a glacial terminal moraine would probably be that the outcrop represented the tip of a small limestone hill, whose position happened to coincide with the point of maxium advance of the glacier, beneath whose dumpings the hill had nearly been buried from sight. But, as shown by the accompanying sketch, the mine workings prove the limestone, containing the vein, to be simply an isolated mass, which is about 200 ft. in length, 150 ft. in width, and about 50 ft. in maximum thickness, so far as can be determined, and which reposes on morainal material that must be from 300 to 400 ft. in thickness at this point. This limestone mass can have attained such a position only through transportation by glacial ice, and since it occupies the crest of the moraine, and only its edges are covered by later deposited debris, it must have been conveyed to its present site nearly at the end of the Glacial Epoch.

The topography of this portion of the Lemhi range has obviously changed but little since the last Glacial Epoch, and indicates that this mineralized limestone block must have been carried at least half a mile and possibly as much as a mile. This conclusion is strengthened by the fact that similar limestone, traversed by veins of oxidized silver-lead ore of identical character, outcrops from half a mile to a mile up the valley above the terminal moraine. Beyond this section, up to the cirque at the head, the valley walls consist entirely of quartzite.

The history of the "Little Hill" mine may now be summarized. The limestone block containing the ore was originally part of a limestone cliff, traversed by a silver-lead vein that once bordered the glacier between half a mile and a mile above the terminal moraine. Weakened by glacial sapping, a portion of this cliff parted from the main limestone mass, and relapsed into a recumbent position upon the glacier. The fact that the limestone block, although badly shattered throughout, is still intact and in one mass indicates that it did not fall from any considerable height or with much momentum. Thus dislodged from its original position, this limestone block was slowly transported down the valley on the back of the glacier, until in the course of few or many years, according to the rate of glacial progress, it eventually reached the terminal moraine, half a mile to a mile below, and was there deposited by the melting of the ice from beneath it. This event appears to have happened only a short time before the beginning of the climatic change that terminated the last Glacial Epoch and brought about the recession and eventual disappearance of the glacier.

Zinc Industry Booming in Britain

SWANSEA has been for many years the most important center for the manufacture of spelter in Great Britain, says the London *Times*, and after the many vicissitudes of recent years it is gratifying to be able to state that, although trade in many branches is still bad, this industry has conspicuously revived during the last year, and is now in a healthy and active state.

Makers are today turning out as much metal as possible into a market ready to absorb all they can supply.

There have been no changes in the ownership of the works, but initial operations are now taking place at the Emu Works, near Skewen, with a view to the production of spelter there in the near future.

The method of production which has been employed for years, and is still used, is that of gas firing for the distillation of spelter. The ores go through an initial process of roasting, which is carried out in hand-worked furnaces. Mechanical furnaces have been tried for this operation, but with little success. A departure has lately been made at the English Crown Spelter Works, where a plant for roasting by a method of sintering the ores has been erected. This is the only development on the mechanical side which has taken place during the last year.

Ore Supplies Confined to Australian Concentrates

Until a few years ago zinc blende and calamine were used locally as raw ores. Most of these ores were comparatively rich in metal content, especially calamine. Calamine is now difficult to obtain, and blende has been replaced by Australian concentrates, which are almost exclusively used. The supply of these concentrates is good, and large cargoes arrive at Swansea periodically for later distribution among the various spelter works.

The galvanizing works are the chief consumers of the spelter produced in the Swansea area. A considerable quantity is also imported, and for some time Belgium has been sending supplies. Galvanized sheets are mainly sent abroad, although home consumption accounts for considerable quantities. The demand for these sheets has been good.

America a Possible "Serious Factor"

Foreign competition is keen, and is a factor in the regulation of local prices. Production costs are cheaper in Belgium, Germany, and elsewhere on the Continent. At present Belgium is the chief competitor, and large parcels of spelter found their way into the Swansea district from that source. The United States, which has always been regarded as a serious factor, is not a keen competitor today, American prices being just above Swansea's. Should the market price rise to £35 to £36 per ton, American competition will again be felt. Stocks of spelter have been at a minimum, and it is safe to say that there are practically no unsold parcels at present on hand.

With regard to future months, there are indications of a further period of prosperity, as the demand for galvanized sheets is good and makers are covered with orders in hand for forward delivery. The recent catastrophe in Japan has also given a fillip to the market, and the demand for sheets from the Far East will favorably affect the trade for some time. This in turn reacts to the benefit of the spelter trade, and, in conjuction with a good general demand for galvanized sheets, suggests continued success next year for all engaged in the manufacture of spelter.

Interpreting Time-study Data of Mining Operations

Necessary Preliminary to Establishment of Scientific Method of Paying by Bonus or Piece Work

By W. F. Dietrich

Chief Efficiency Engineer, Compañia de Santa Gertrudis, Pachuca, Mexico

IN THE ORGANIZATION of efficiency work at a given property it is necessary to accumulate a large number of time studies of all the routine mining operations under various conditions and with different workmen, to determine the best methods of performing each operation and to set fair standards of performance. The collecting of these data may extend over a number of years, and a suitable system of recording and filing must be devised to permit ready and accurate comparison and interpretation of the results. The system herein described has proved successful under the conditions at the Cía. de Santa Gertrudis of Pachuca, Mexico, and may be of use to others who wish to undertake similar work.

A decimal classification system is used, combined with certain mnemonic symbols. An outline of this system is given in Table I. As in any classification, it is impossible to avoid certain incongruities, as one cannot always proceed from the general to the specific in direct succession without introducing unwarranted complications.

Table I—Classification of Time-study Data

Processes

100 Drilling and blasting
200 Loading and handling broken rock
300 Timbering
400 Distribution of supplies
500 Installation of underground equipment
600 Shop work

200 Loading and Handling Broken Rock

10	Side-dump 700 kg. motor cars
20	End-dump 700 kg. hand cars
30	Side-dump 600 kg. hand cars
40	End-dump 500 kg. hand cars
60	Wheelbarrows
70	Shoveled direct to chute
80	Chute pulling direct to dump, etc.
90	Skips, buckets, etc.
1.	Loading
0.1	Use this decimal for no. of men
0.01	With shovels, no flat-sheet
0.02	With shovels, flat-sheet, round-point shovel
0.03	With shovels, flat-sheet, square shovel
0.04	From chute with wooden doors
0.05	From chute with straight, hinged, iron door
0.06	From chute with arc door
0.001	Coarse rock (many boulders greater than 10 in. diameter)
0.002	Dry medium rock (most of rock from 2 in. to 10 in. diameter)
0.003	Dry fine rock (most of rock less than 2 in. diam.)
0.004	Wet, moderately sticky rock, some large boulders
0.005	Wet, sticky rock, mainly fine
2.	Car tramming, suffix "M" for motor haulage. State no. of cars per train. "L" for loaded. "E" for empty vehicles
0.1	Use this decimal for no. of men
0.01	Distance in 50 M. Use superscript numbers for multiples beyond e.g. 0.00^2 = 500 M. $.01^2$ = 550 M., etc.
0.001	Grade in ½ per cent; suffix "U" for grade against load. "D" for grade with load
3.	Switching and spotting cars or trains; suffix "M" for motor haulage
0.01	Entering and passing fixed-point switch
0.02	Entering and passing movable-point switch
0.03	Switch back, fixed-point switch
0.04	Switch back, movable-point switch
0.05	Spotting cars for loading
0.06	Spotting cars for dumping
0.001	Grade, as above
4.	Wheelbarrow tramming, dirt floor
0.01	Distance in 5 M.; superscript numbers as under 202.01
0.001	Grade, in ½ per cent; suffixes as under 202.001
5.	Wheelbarrow tramming, plank floor
0.01	Distance in 5 M.; superscript numbers as under 202.01
0.001	Grade, in ½ per cent; suffixes as under 202.01
6.	Dumping
0.1	No. of men
0.01	Through grizzly
0.02	Into fill
0.03	Clearing grizzly
0.04	Spreading dump
0.001	Condition of rock, as under 201.001, etc.
9	Delays, as under 109

In addition to the symbols given, it is necessary to add distinctive notation, so as to segregate different series of studies of identical operations. For example, two successive drilling tests in different rock with a Waugh model 76 self-rotating water stoper would receive the symbols 132. R, Waugh 76-A; and 132. R, Waugh 76-B; whereas similar tests in the same two places with an Ingersoll-Rand model L-41 self-rotating water stoper would be designated 132. R, I-R. L41-A; and 132. R, I.R. L41-B.

The original data are recorded in serially numbered, cloth-bound memorandum books, 4¼ by 6½ in. in size, ruled into columns. A continuous time record of the operation is kept, noting the stop-watch time on each change in operation. A column is provided for the use of symbols, which are in general a simplified modification of the main classification system already described.

Loose-Leaf System Not Essential

A loose-leaf system was considered in place of the bound notebooks, but it is doubtful if the initial cost and filing expense would be justifiable, in view of the fact that, in any case, summary sheets are needed, so that the original data, once posted and checked, need seldom be used for reference.

From time to time the time-study books are left in the office, where a clerk calculates (or merely checks) the intervals in minutes and decimals, adds the time required for each operation, and posts the results on 8½ by 11 in. Time-study Summary sheets (Fig. 1). In general, one line is used for each complete cycle (that is to say, a drill hole), and the columns are labeled in accordance with the operations, units of work, and other operating factors. Calculations of averages can be made at any time, and additional results can be added as obtained.

When a given series of observations is completed, and the necessary calculations have been made, the totals and averages of each individual operation are posted on 5 by 8 in. cards (Fig. 2). At first sight, the need for the cards may not be apparent. They serve to condense and segregate the data on the sheets, for convenience of reference and in making up standards for the various sequences of operations which constitute a given cycle.

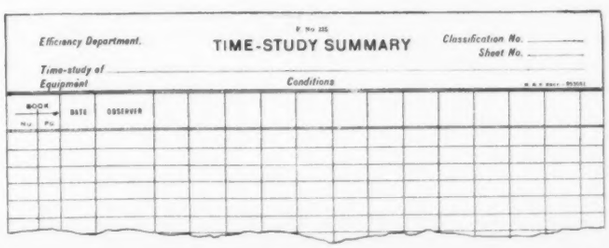
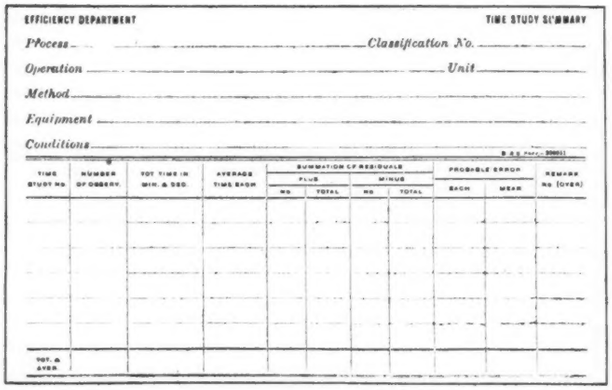


Fig. 1.


EFFICIENCY DEPARTMENT — TIME STUDY SUMMARY

Process ..... *Classification No.* .....

Operation ..... *Unit* .....

Method .....

Equipment .....

Conditions .....

TIME STUDY NO.	NUMBER OF OBSERV.	TOT. TIME IN MIN. & SEC.	AVERAGE TIME EACH	SUMMATION OF RESIDUALS				PROBABLE ERROR		REMARKS (USE NO. OVER)
				PLUS		MINUS				
				NO.	TOTAL	NO.	TOTAL	EACH	MEAN	
TOT. & AVER.										

Fig 2.

In general, three simple methods are available for judging the reliability and the sufficiency of a series of observations: Probable-error calculations; maxima and minima curves; and distribution charts. The probable-error method, using Peter's approximation formulas, has proved the easiest to apply under the conditions here discussed, as the calculations can be easily taught to Mexican clerks, and are readily checked. The principle of maxima and minima is often applied by eliminating obviously erratic or erroneous results, usually by pairs of extremes. The distribution chart has as yet found little application in the interpretation of results at Santa Gertrudis, but seems to have its principal value in the determination of standards of work from studies of different men performing the same operation, as well as in the elimination of results obtained from observations of men unsuited to their work.

Probable-Error Calculations

In the routine application of probable-error calculations to the comparison of two sets of data of two distinct methods of performing the same operation, if the range of probable values of the mean of one set of observations does not overlap the range of the other set, it may safely be assumed that one method is decidedly less efficient than the other; whereas if there is an overlap of the values of less than 50 per cent, it is usually necessary to secure more data, so as to be certain whether there is a real difference of efficiency between the two methods, or they can be considered as of practically equivalent efficiency. However, if the entire range of probable values of the two series, even though the values of each series only slightly overlap, is within the limits of a single standard of work, it is not worth while to attempt differentiation of the two cases. The examples in Table II illustrate the points covered in this paragraph.

Table II—Probable Errors of Tests of Various Machine Drills Under Identical Conditions

Drilling Speed in Inches per Minute

Machine No.	Mean	Probable Error of Mean	Range of Probable Values	
1	11.6	±0.40	11.2	12.0
2	11.0	±0.32	10.68	11.32
3	10.8	±0.60	10.2	11.4
4	9.6	±0.40	9.2	10.0

Let it be assumed that within the limits of these tests a range of 1.6 in. per minute can be allowed for each rock classification requiring a separate standard of performance. Machine No. 4 can immediately be eliminated from consideration, as its range of probable drilling speed lies entirely below any of the others. Machines Nos. 1, 2, and 3 are not so easy to segregate, as their probable drilling speeds overlap, and the means are within 0.8 in. per minute of each other. Nos. 1 and 2 overlap to the extent of 9 per cent, but the entire probable range of the two is less than 1.6 in. per minute, and hence little is to be gained by continuing the tests further in the same class of ground, and the choice of drills must be made entirely from other considerations, such as first cost, maintenance cost, air consumption, and ease of handling, although tests in other classes of rock may indicate a real difference in drilling speed, so that one of the machines may prove to have a wider field of utility than the other.

In the case of machine No. 3, its range of probable speed overlaps the ranges of both Nos. 1 and 2, and the extreme range of Nos. 3 and 1 is greater than 1.6 in. per minute. Though it is probable that No. 3 is actually inferior to No. 1 in drilling speed, it is necessary to obtain more data, preferably on the former, so as to be reasonably certain that the difference does not lie solely in the errors of observation. It may not be practicable to differentiate between Nos. 2 and 3, however, on account of the relatively large number of tests that would be needed.

There are a few mathematical features in connection with probable-error calculations that may be of value to those who wish to use them in routine practice. In the first place, the distribution of the positive and negative residuals should be nearly equal—that is, there should be nearly the same number of results greater than the mean as those less than the mean. If not, it is an indication of insufficient results, or the inclusion of results containing irrelevant, infrequent, or abnormal factors, the result of insufficient segregation by the time-study man. A check on the calculation of residuals is obtained by the fact that the summation of the positive residuals should equal the summation of the negative residuals.

Maxima and Minima Curves

Fig. 3 shows a maxima and minima curve of a series of observations of wheelbarrow loading, the arithmetical average of which is 2.18 minutes each. Semi-logarithmic ruling is used to bring out the variations in their true proportion. The case selected illustrates the general form of such curves, but a great many more observations would be needed to give a curve showing the abrupt extremes and flat central part of the ideal curve. On the principle that the extremes represent abnormal results, we may be justified in eliminating thirteen maxima and nine minima, leaving that portion of the curve from *A'* to *B*, which gives a new average of 2.04 minutes per wheelbarrow.

The probable errors of the three different cases are given in Table III.

Table III—Comparison of Probable Errors. Time Studies of Wheelbarrow Work

Observations Included	Number of Observations and Distribution of Residuals +	0	—	Total	Mean (Min.)	Sum of Residuals	Probable Error Each	Mean
1. Entire series	35	5	54	94	2.18	47.44	0.43	0.044
2. Except 13 maximum and 9 minimum	35	0	37	72	2.04	19.93	0.24	0.028

It is seen that Case 2 not only gives the lower probable error but also the best distribution of the residuals. Because of the large amount of labor involved, maxima and minima curves are seldom used in routine practice. In fact if enough observations are available to give a useful maxima and minima curve, the probable-error

calculation generally shows that the averages are within reasonable limits of accuracy, and the reliability of the results can be improved by elimination of extremes by inspection. For example, in the case given above, it would make no vital difference if a standard of 2.18 minutes were selected instead of 2.04 minutes, as there is less than 10 per cent difference between the two standards.

Distribution Charts

Fig. 4 is a distribution chart of the series of observations discussed under maxima and minima curves, and includes the entire series of ninety-four observations. The chart is based on percentage of time efficiency, assuming the average of 2.18 minutes as 100 per cent efficiency. The distribution of the results is seen to be fairly uniform and in accordance with a normal chart of this type, excepting for the reversal of normal distribution at 130 per cent and 140 per cent, which is unimportant. Only sixteen results fall outside of the range between 75 per cent and 175 per cent efficiency, showing that if 2.18 minutes is selected as 100 per cent standard time, there would be comparatively few men unable to attain at least 75 per cent of the standard; whereas, on the other hand, but few would be able to double the standard (200 per cent), if working at a pace that could be continued throughout the shift.

Time Studies Only One Factor in Determining Standards

In the actual determination of time standards upon which to base wage payments, many factors must be considered in addition to time-study averages. No matter what method of payment is used, standards must be set that not only are attainable by an average man working efficiently at a normal pace, but also that will result in economy to the company under all conditions. The time standards must be low enough to make it possible for the company to recoup its losses on the men who exceed the time allowance and yet not so low that the workman will consider them beyond his capacity or as not worth striving for in consideration of the rewards offered. A fact not to be overlooked is that the company should have a definite incentive to improve conditions and to eliminate unfit workmen.

Much depends upon the method of payment. A contract or 100 per cent bonus system requires at least 25 per cent lower time standards than a so-called 50-50 bonus system. Within certain limits, the company does not need to guard against failure to attain standards in a straight contract system, whereas in all systems in which a fixed wage is guaranteed, standards must

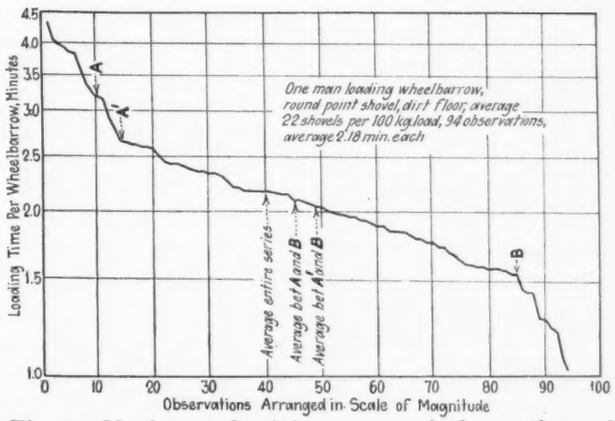


Fig. 3—Maxima and minima curve of observations of time of loading wheelbarrows

be low enough to cover these losses. A few definite examples will be given, taking the case of an operation in which twenty units per hour represents 100 per cent efficiency. In all cases, six hours is adopted as the standard working time per shift. At the mine where the observations were made the total shift is 7.5 hours, but practically one hour is lost traveling to and from the shaft to the working place, leaving 6.5 hours net working time, of which one-half hour is allowed for lost time and resting. The standard wage is $0.90 (United States currency) per shift, or $0.15 per working hour.

It is assumed that after a given system has been installed the average efficiency of all the workmen will be 100 per cent, and that the efficiency per man-shift will be distributed as in Table IV.

Table IV—Idealized Distribution of Efficiency; Average 100 Per Cent

Per Cent Efficiency	Per Cent of Total Man-shifts at Given Efficiency	Per Cent Efficiency	Per Cent of Total Man-shifts at Given Efficiency
50	2.0	130	5.0
60	3.0	140	3.2
70	5.0	150	2.2
75	7.0	160	1.5
80	10.0	170	1.0
90	16.0	180	0.6
100	24.5	190	0.3
110	11.0	200	0.2
120	7.5		

It is further assumed that records of performance over a period of years show that an average of 75 per cent efficiency was obtained under day's pay or other systems not involving an individual incentive. Thus the previous direct labor cost to the company was 1.0c. per unit, and any change in method of payment must not only show a lower average cost per unit but also increased earnings for the workmen.

Table V—Comparison of Direct Unit Labor Cost and Earnings per Hour With Various Standards and Methods of Payment

Standard wages per hour = $0.15; units per hour at 100 per cent efficiency = 20; standard cost based on past performance = 1c. per unit (75 per cent efficiency); man-shift distribution of efficiency under individual incentive as in Table IV

		Cost per Unit, Cents				Wages per Hour, Cents			
	Per Cent of Men Earning Bonus	Maximum at 50 Per Cent Efficiency	Minimum at 200 Per Cent Efficiency	Average	Per Cent Average Increase or Decrease	Minimum at 50 Per Cent Efficiency	Maximum at 200 Per Cent Efficiency	Average	Per Cent Average Increase
Case 1 Piece rate or contract									
a. 75 per cent base	83	1.0	1.0	1.0	0.0	10.0	40.0	20.0	33.3
b. 86 per cent base	67	0.875	0.875	0.875	—12.5	8.75	35.0	17.5	16.7
c. 100 per cent base	33	0.75	0.75	0.75	—25.0	7.5	30.0	15.0	0.0
Case 2: Day's pay and 100 per cent bonus									
a. 75 per cent base	83	1.50	1.00	1.01	+1.0	15.0	40.0	20.2	35.0
b. 90 per cent base	57	1.50	0.83	0.87	—13.0	15.0	33.3	17.4	16.0
c. 100 per cent base	33	1.50	0.75	0.82	—18.0	15.0	30.0	16.4	9.3
Case 3: Day's pay and 75 per cent bonus									
a. 75 per cent base	83	1.50	0.84	0.95	— 5.0	15.0	33.5	18.9	26.0
b. 90 per cent base	57	1.50	0.72	0.84	—16.0	15.0	28.75	16.8	12.0
c. 100 per cent base	33	1.50	0.66	0.80	—20.0	15.0	26.25	16.0	6.7
Case 4: Day's pay and 50 per cent bonus									
a. 60 per cent base	95	1.50	0.81	1.00	0.0	15.0	32.5	20.0	33.5
b. 75 per cent base	83	1.50	0.69	0.88	—12.0	15.0	27.5	17.6	17.3
c. 90 per cent base	57	1.50	0.60	0.81	—19.0	15.0	24.2	16.2	8.0

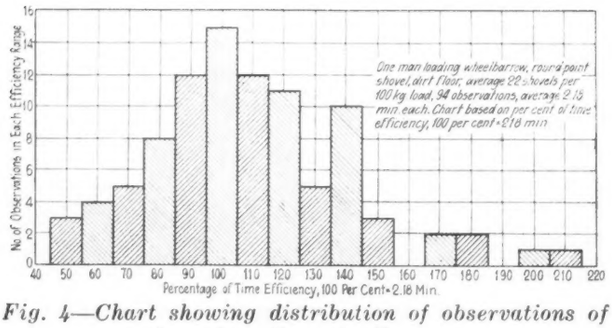

No. of Observations in Each Efficiency Range
Percentage of Time Efficiency, 100 Per Cent = 2.16 Min.
One man loading wheelbarrow, round point shovel, dirt floor, average 22 shovels per 100 kg load, 94 observations, average 2.15 min. each. Chart based on per cent of time efficiency, 100 per cent = 2.16 min.

Fig. 4—Chart showing distribution of observations of time of loading wheelbarrows

Based on the foregoing assumptions, Table V gives the cost per unit and the wages per hour that can reasonably be expected with various standards and methods of payment. None of the differential sliding scale methods of payment are included.

Reference to the table shows that Case 1, a and c; Case 2, a; and Case 4, a, can be eliminated at once, as they either fail to provide an incentive to the company or to the men.

Case 1, b, is the best choice if a straight contract or piece-work system is used. The cost per unit is fixed and results in a saving to the company of 12.5 per cent compared to past results, provided the company is under no legal or moral obligation to pay a minimum wage. If the men put forth their best efforts, their average wage will be 16.7 per cent greater than before, but only 67 per cent of them will earn more than the standard wage, and many of the remaining 33 per cent will earn considerably less than that, a condition that is certain to cause trouble if not rectified. If the labor supply is ample, the less efficient men can be eliminated or transferred to other work, thus tending to increase the average earnings of the others, but the company would not share in this increased efficiency.

Case 2, b, is preferable to 2, c, and in most instances to Case 1, b, as a standard wage is guaranteed to the men, yet the company and the men share almost on an equal financial basis in the increase of average efficiency from 75 to 100 per cent. However, only 57 per cent of the men have a reasonable chance to increase their earnings above the base, and in case of a general average improved efficiency beyond 100 per cent, the company has little or no incentive to maintain conditions that will make it possible for each man to do his best work.

Case 3, b, and Case 4, b, provide adequate incentives for the company as well as the men. Each increment of efficiency results in a decrement in the cost per unit throughout the entire range of efficiency, and each increment of efficiency above the base (90 per cent and 75 per cent respectively) results in an increment of earnings for the workman. Case 4, b, probably represents the best balance of the various factors, and allows 83 per cent of the men to increase their earnings. However, the so-called 50-50 bonus system does not always appeal to the men, who argue that the company takes too great a proportion of their increased earnings, and it is difficult for them to realize that with such a system the standards can be based on a lower percentage of efficiency, thus making it easier to earn a bonus and providing a substantial incentive to a greater proportion of the men.

In many cases it will be found that a differential bonus scale gives the best solution to the problem, by providing large incentives for the first increments of efficiency above the base, and progressively smaller incentives for further increments of per cent efficiency. Indeed, a differential scale is more scientific than the straight bonus, as a series of numerically equal increments of percentage efficiency have in reality a logarithmic rather than a straight-line relationship to any given base.

Red Mountain, in the San Juan of Colorado

On the million dollar highway between Ouray and Silverton. One of Colorado's early-day silver districts

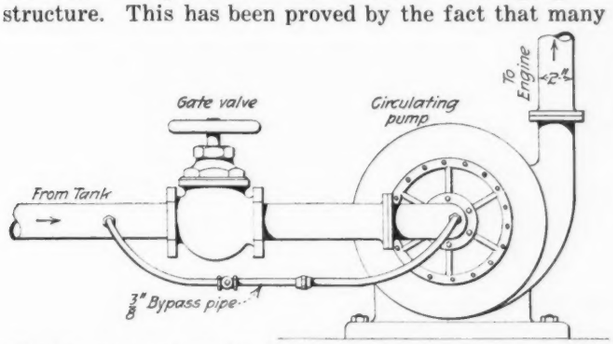
Useful Operating Ideas

Prevention of Cracked Cylinder Heads

By Charles Labbe

Users of semi-Diesel and oil engines have frequently experienced trouble from cracked cylinder heads. This is usually the result of too rapid expansion and contraction of the cylinder-head casting, due to the temperature changes from full load to no load, or the reverse.

The difference of temperature of the inner surface of the combustion chamber and of the surface in contact with the cooling water probably varies several hundred degrees. Rapid cooling or heating strains the metal. Repetition of this results in changing its structure. This has been proved by the fact that many



The bypass used on this circulating pump has averted the cracking of the cylinder head caused by too rapid cooling

cracked cylinder heads have been welded, the work being done as well as possible and the part annealed. When put back into service, often after a week or more, a new crack would open up between two welds or else in a new place, showing that the metal had been altered by the successive heating and cooling.

In one instance the cooling water obtained from the mine was the cause of trouble. It contained lime, which was deposited as a scale in the cooling spaces between metal and water, thus allowing the inner surface (combustion chamber) to become overheated. The water to the engines was supplied by circulation through cooling tanks and a tower, the resulting evaporation, which was large, being compensated for by adding water when necessary. The quantity of solids in suspension thus increased continually. The piping at the tanks was rearranged so that all the water could be changed once a day. As a result less sediment accumulated in the engines.

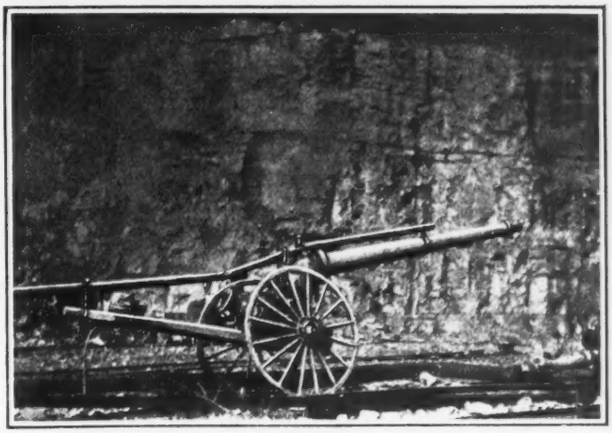
It was afterward discovered that most of the cylinder-head cracking occurred during the quick cooling from full load to no load. The amount of water circulated through the engines by the centrifugal pump was constant regardless of the power developed by the engine. A ⅜-in. bypass pipe was inserted on the intake of the circulating pump, as shown in the accompanying illustration. When the load was thrown off, the gate valve on the inlet pipe was shut off by the engineer and only a ⅜-in. stream of water could be circulated. This gave more time for cooling. The gate valve was not reopened until a little while after the load was on. In addition to the foregoing the temperature of the inlet water was maintained at 85 to 90 deg. and the outgoing water at from 125 to 135 deg. This gave less chilling and also facilitated the lubrication. Smaller tanks were used and a larger quantity of water was circulated to obtain this temperature range.

The simple bypass is safe for the centrifugal pump. The size of pipe to be used will depend on the variations of loads and local conditions; a pipe about one-fifteenth the area of the circulating pipe will usually answer for a bypass, the important point being to keep the temperature nearly uniform by using the thermometer on the engine cylinders as a guide. Different grades of fuel give slight variations of temperature. A lighter fuel does not require as warm cylinders as a heavier one. The cylinder oil must be carefully selected, often after many trials.

Use of Mounted Monitors in Stripping

By R. Franklin Mundorff

In open pits and quarries, thin overburden and intermixed sand and clay are best removed by washing with a heavy stream of water directed by a nozzle or monitor. In the quarries of the Greer Limestone Co., Greer, W. Va., the washing plant installed for this purpose consists of a 6-in. centrifugal pump connected to a 4-in. pipe. This pipe is connected to a 100-ft. hose attached to the monitor. The monitor is mounted on wheels so that it can be easily moved about. The water pressure at the 1.75-in. nozzle is 175 lb. Clay overburden has been readily removed and the debris washed away more effectively than could have been done by hand labor or by the use of steam shovels. The mounting of the monitor is shown in the accompanying photograph. Another view showing the monitor in action will be found on the front cover of this issue.

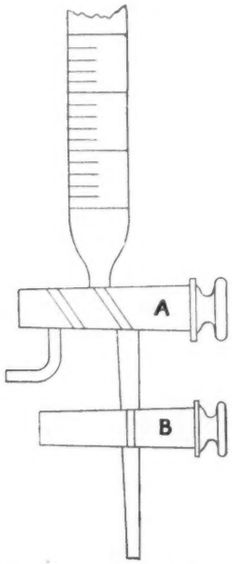


Monitor, mounted on wheels, used for stripping thin overburden

Burette for Cyanide Coppers

By S. A. Madrid

The use of the cyanide method for copper determinations depends for accuracy on the maintenance of titrating conditions in samples and standards as uniform as possible. The burette shown in the accompanying figure has been found to facilitate the work. It is of the ordinary three-way type to which a two-way cock is attached. To operate, fill burette as usual, then open *A* and then *B*. Next, close *B* gradually until the proper speed is obtained. *B* is then left in its position throughout the day's work, all the filling and stopping being done by *A*. By the use of this burette all the samples are titrated at the same speed, as are also the standards. Consequently greater accuracy results.



Burette designed to facilitate titration of cyanide coppers

The method used in making the copper determinations is as follows:

Weigh 0.5 gm. of ore into a 180 c.c. beaker; add 7 c.c. nitric acid and about 0.3 gm. potassium chlorate. Boil slowly until decomposed; remove from hot plate and add 40 c.c. cold water. Add just enough ammonia to produce the blue ammoniacal solution. Filter and wash with sufficient cold water to bring the filtrate to from 80 to 100 c.c. The solution after titration should be clear and colorless. If brownish or discolored, the addition of more chlorate during digestion will remedy this condition. For oxide copper, treat two grams of ore with 10 per cent sulphuric acid solution; heat to boiling point; remove from heat, cool, and add 40 c.c. cold water and a slight excess of ammonia. Place on the hot plate and boil gently for a few minutes; remove and allow to cool. Add sufficient cold water to bring solution to about 60 c.c., add 4 to 5 c.c. ammonia, filter and titrate as described before. By filtering into a flask time is saved by agitating instead of stirring in a beaker.

Transportation by a Single Ropeway

By C. M. Eye

Some years ago I had occasion to transport a quantity of jointed wood stave pipe across a gulch with steep banks which precluded the building of a road for the purpose. A temporary, overhead, single ropeway was erected at moderate expense from materials at hand. The lay of the ground was such that the loads were handled by gravity, but provision had to be made for regulating the speed of travel and for quickly returning the empty carrier. To accomplish this, a small single drum hoist with driving gear disconnected, but with brake retained, was set up in line with the rope back of an A-frame on the loading side. The drum shaft had a capstan head on its extension, which was replaced by a drum of about one-sixth the diameter of the main drum. A rope attached to the carrier was wrapped on the larger drum, and a lighter rope, wound in the reverse direction, led from the smaller drum to a sheave set directly above and thence to another, a short distance away, both sheaves being fastened under a beam attached to a convenient tree at a height proportional to the travel of the carrier, or as the relative diameters of the two drums. A light mine bucket, partially filled with rock, was attached to the end of the lighter rope so that as the load ran by gravity across the gulch, the bucket was hoisted.

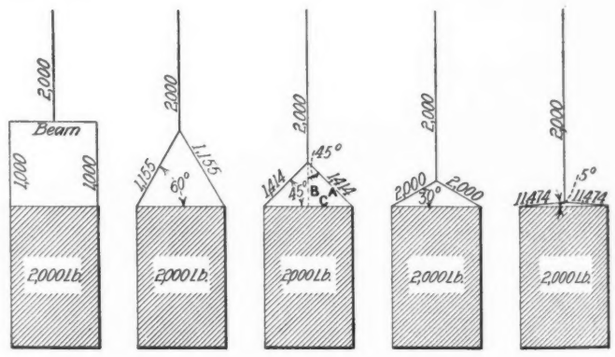
When the carrier had been unloaded, the descending bucket, acting through the two ropes and drums, brought it back to the loading side. A little experimenting was necessary to determine the proper load of the bucket. The operation was under the control of the brake at all times. By means of this device, a load of eight or ten lengths of 14-in. pipe was transported across the 300-ft. span every ten minutes, two men at each end being required for its operation. The total cost of erecting and dismantling the ropeway, including cost of making the carrier, was approximately $175.

Cable and Rope Slings

By Allen P. Child

In using cable and rope slings, a pad of rags at each sharp corner prevents the cable or sling from being weakened or cut at the corners. The accompanying illustration in use by a Michigan power company shows the stresses resulting in rope slings under different conditions. The numbers in the diagram give the pull in pounds when a load of one ton is lifted by a single cable sling. As will be noted, the stress in the sling indicated on the right is between eleven and twelve times as great as that on the left. A long sling about a wide object will therefore result in lower stresses than where the sling is tightly wrapped about the object.

The line *A* in the third diagram represents the right-hand part of the cable. It is necessary for this to carry one-half of the load of one ton, or 1,000 lb. A crushing force is exerted at the same time as lifting occurs. This tends to decrease the distance represented by the line *C*. A simple triangle of forces gives graphically the magnitude of both the force in the line *C* and also in the line *A*. The hypothetical line *B* is drawn to a scale of 1,000 lb. to one or two inches, as may be desired.



Diagrams showing stresses in rope slings under different conditions

Discussion

"Engineering and Mining Journal-Press" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief.

The Microscope and the Decadence of Geology

THE EDITOR:

Sir—The editorial in the July 19 issue of the *Engineering and Mining Journal-Press* entitled "The Microscope and the Decadence of Geology," states that geological science is in the doldrums. The editorial refers particularly to mining geology. In my opinion the same judgment should be passed on the science as a whole. Certain signs of a waning vitality in the science, particularly as it touches the academic field, are the following facts:

1. The failure of the present generation to develop men of outstanding pre-eminence in the field of general geology. It is men of this type with an aptitude and capacity for generalizations based upon familiarity with the accomplishments in the various branches of the science who will restore to geologists the capacity to see natural phenomena as they exist. The field of geology is now occupied by technicians rather than by scientists. This lack of young men of the type desired is gradually accomplishing a loss of contact with popular interest. To many people geologists are plain "nuts," whereas the scientist of earlier days was anything but the oddity that this word suggests, and these men presented geological matters in a way that caught the attention and aroused the interest of large numbers of people. There seems to be a general failure on the part of geologists today to find matters of interest common to themselves and to the educated public. Geology appears to have no popular spokesman.

2. The wholesale desertion of the field of general geology for the field of commercial geology, particularly as applied to the occurrence of oil and gas. In many instances this change has meant the gradual assumption on the part of the "petroleum geologist" of more and more of the executive work and the eventual abandonment of all scientific work. Other men whose interest was once primarily geological are now "petroleum technicians." The temptation presented to young men of the present academic generation is to do what many of the older men seem to have done and use geology as a stepping stone to advancement in the commercial field. Thus there are attracted to the science men whose interest is not primarily scientific but technical, and among such men one can hardly hope to find luminous examples of the "scientific attitude." The particular loss to the science in this process, however, consists of the older generation of geologists whose early devotion to the science is unquestioned but whose time is now largely occupied in the consideration of matters ungeological.

3. The curtailment of expenditures for public geological surveys, particularly those of a strictly scientific non-technical character. It is a question whether there is any more stimulating form of investigation to which a young geologist can give his time than that involved in the devotion of successive field seasons in areal geological work, in the preparation of maps such as those found in many of the folios of the Geological Atlas of the U. S. Geological Survey, and in some state reports. It is unfortunate that so little of this work is now being done. In the years from 1894-1914, 195 U.S. Geological Survey folios were published; since that time only 25 more have been published. The teacher of today is sadly at a loss for proper openings toward which he can direct young men whom he desires to receive the sort of training that areal geologic mapping gives when carried on under competent direction. "Petroleum geology" does not offer comparable training, and suffers because such training is not more readily possible. Resumption of an enlarged program of areal geological mapping on the part of public surveys will do much to drive academic geology out of the doldrums.

4. The innocuous character of most of the recent geological literature. No doubt this quality of the literature was the main inspiration for the editorial under discussion. If there is cause to remark that for many years geology has taken no step forward, assuredly there is reason for thinking that the literature of geology is not particularly stimulating. Some of the older geological literature is correctly so called; much that is printed now is only technical discussion. One wonders at the silence of the writers, many of them still living, who in the journals of twenty years ago seemed to give promise of some definite contribution to the science.

5. The Ph.D. complex. The training of the young geologist of today beyond his undergraduate years is carried on almost entirely in institutions in which the graduate work leads to advanced academic degrees, particularly the degree of Doctor of Philosophy. Presumably, this is a scholastic and not a professional degree. Since, however, there are no geological professional degrees, the doctor's degree to a considerable extent takes the place of such a professional degree. To such an extent is this true that the acquisition of the degree is considered necessary before expecting advancement in the academic field, and it is considered as not unimportant in influencing advancement in the commercial field. As a substitute for a professional degree the academic degree is unsatisfactory, because the technical requirements are not sufficiently uniform or rigidly enforced. As a scholastic degree it is rapidly becoming unsatisfactory, because of the increasing number of technical requirements and the emphasis placed upon extended research in one of the technical branches.

What seems to be necessary is a procedure that will separate technical from scholastic attainments such that distinction in the field of interpretative geology will receive recognition over and above that received for technical skill. Much of the so-called advanced work in geology is technical investigation in some related science, such as chemistry, zoology, or physics, and it is

a question whether or not the chemist, zoologist, or physicist with some geological training, or having the problem indicated by the geologist, is not better equipped to handle the problem than is the geologist, with his usual limited training in any one of these subjects.

Over against these signs of a falling vitality in geological science there are others, at least in the academic field, that may be regarded by some as encouraging. Of these the most noteworthy is the growth in the departments of geology in the colleges and universities of the Mississippi Valley. Possibly the same growth has been experienced elsewhere. To a considerable extent this increase parallels the general increase in enrollment in these same institutions, but in some cases at least it considerably exceeds the normal expected increase. It appears to me, however, that the real vitality of the science is to be read in the number and quality of the young men who are selecting and keeping their interest in the larger fields of geological science. It is believed that their number is smaller than formerly; we hope that improvement in quality is more than keeping pace with decrease in numbers.

University of Arkansas. GILBERT H. CADY.

THE EDITOR:

Sir—I have read with great interest your editorial in the issue for July 19 on "The Microscope and the Decadence of Geology." This editorial seems to me to bring out a fact of great importance. I suppose that it is inevitable that the development of a very interesting branch of science, like the use of the microscope, should rather blind many of the leaders in this work to other methods of observation. This is a temporary disadvantage we must suffer in return for a future gain.

In the long run, when the proper prospective has been gained, the use of the microscope is sure to be most helpful in the discovery of ore. But I have yet to hear of a case in which a great mine or even a great orebody has been discovered through the use of a microscope. As you imply, we are still only at the beginning of the renaissance in geology.

I think it was a famous Headmaster of Rugby who said that if you hold a shilling close enough to your eye it will cover the whole world, and the only remedy is—to open the other eye. I think we geologists need to open the other eye. IRA B. JORALEMON.

San Francisco, Calif.

Furnace Methods of Treating Phosphate Rock

THE EDITOR:

Sir—In a recent number of the *Mining Journal-Press* you print an inquiry in regard to the new processes by which phosphate is made soluble without the use of sulphuric acid, to which I made reference in the article on gypsum that appeared in the *Mining Journal-Press* on March 8, 1924.

In answering the inquiry you called attention to the work of Dr. Lipman and his staff at the New Jersey Agricultural Station, in which phosphate is made soluble by biological means. In my article I had reference especially to the work of William H. Waggaman and his associates at the Bureau of Soils, Washington. The result of this work seems most encouraging and permits of the use of lower-grade phosphate than is practical for the sulphuric acid method.

The following extracts from recent publications describe the process used by Waggaman, and the Kreiss and Swann processes:

"Briefly the process (Waggaman) consists in submitting intimate mixtures of phosphate rock, sand, and coke to the high temperatures attained either in an electric or fuel-fired furnace, thereby driving the phosphoric acid out of the phosphate rock and replacing it by silica, the final product being relatively pure phosphoric acid and silicate of lime. The former is volatilized and collected in some suitable manner and the latter is dumped out of the furnace from time to time as a molten slag.

"Briefly, the process (Kreiss) consists of mixing phosphate rock with potash in certain proportions, and subjecting materials to a heat treatment. The resulting product is a combination of potash with the phosphate converted from an insoluble form to available form. In this method an actual fertilizer material, potash, is used as the reagent for the conversion, instead of the objectionable sulphuric acid, and the finished material has a tendency to sweeten and improve the soil, rather than increase acidity."

The *Commercial Fertilizer* is authority for the statement that the Southern Power Co. intends to manufacture superphosphates by the Swann process, which it describes as follows:

"W. S. Lee, vice-president of the company, has been in Europe for some months studying the methods employed in the manufacture of superphosphates in that country. It seems, however, that the plan is to use the newer methods of reducing phosphate by the electric-furnace process, similar to that which has been employed at Anniston, Ala., and known as the Swann process. By the Swann process or similar method phosphoric acid will be produced, which will be used as it is now used in England and Europe in general, for the manufacture of superphosphates."

North Holston, Va. FRANK A. WILDER,
President Southern Gypsum Co.

The Position of Tin

THE EDITOR:

Sir—As a regular reader of your most valued paper, you will doubtless permit me to address you in reference to your "London Letter," signed by W. A. Doman. The letter in your issue of July 19 might give the impression to your readers that Mr. Doman obtained from me my views on the position of tin, which is not the case.

In regard to the subject matter, he refers to my view that tin is cheap at £200 and dear at £300. I would never be rash or unwise enough to lay down a maximum of this kind. An article like tin, as everybody connected with the trade appreciates, is regulated not only by law of supply and demand but also very largely by sentiment. Therefore, prophecies in regard to prices are dangerous.

At the moment, supply and demand, broadly speaking, are so nearly balanced that a comparatively small move in one or the other direction can tip over the scales. Consumption in Europe is very satisfactory. In America there has undoubtedly been a slackening off, but unless appearances are deceptive, more tin will be wanted again on your side by the autumn. When this demand materializes, I expect that inroads will be made into the visible supplies; also into the invisible supplies, which are largely composed of the tin held under the

Bandoeng agreement. These stocks will presumably come to an end within about six months, possibly sooner, and increased supplies will then be required from other sources to cope with the demand. Whether we will get the increased supplies from the Straits or Bolivia remains to be seen. I hope, however, that production in these centers will increase as the material will be needed.

C. RICARD.

London, England.

What Is the "Real" Mining Spirit?

THE EDITOR:

Sir—The paper on the "Purchase of Dormant Gold Properties," in your issue of July 12, in my belief is not consistent with the true mining spirit of the years preceding 1913; it more closely parallels the "corner grocer" who very exactingly will mete out a pound of sugar, coffee, or bacon for a set price, knowing positively that the pound of sugar, coffee,or bacon *does* exist.

The real mining spirit—and it is the only one which will have great bearing upon the future opening-up of profitable mines—is justified in assuming and expecting that a reasonable price will be paid for actual ore exposures, together with a fair premium upon the probable merits of the property.

Dormant mines will continue to be such until the "mining man" of today again becomes a relative to our mining men of yesterday, who were endowed with some of the anticipatory spirit of the true prospector, ready and willing to "gamble" on that portion of a good prospect which was not in sight and which was beyond the reach of the tip of his nose.

For instance, an equipped gold property, that has milled thousands of tons of oxidized ores at a profit, has entered and left in place sulphide ores to a depth of 250 ft. with a width of 40 ft., concentrating 4½ into 1, with a value of about $20 per crude ton of ore, and a production cost of less than $5, together with a sacrificial price set upon the property, but it has failed to appeal to men who professionally follow mining because a two to five years' lease and bond is not given before a purchase is made.

Excellent surface and underground indications, a good history, and fine prospects for the future, computed ores in excess of the purchase price and of a character such as make economical recovery of the values most easy, should certainly warrant examination of this property by a "real" mining man, and upon its actual, probable, and possible merits an out-and-out sale should be closed.

The success of a prospect, a partially opened property, as well as a large producing mine must be "square-setted" with "venture and finance" if profitable mining is to prosper and endure.

F. A. MUELLER.

Constellation, Ariz.

Mount Isa

THE EDITOR:

Sir—In your editorial comment upon my Mount Isa article, you state that Mount Isa is only 100 ft. above the sea and is about 200 mile south of Cloncurry, where the Mount Elliott mine is situated. The district is 1,200 to 1,500 ft. above the sea level. It is 66 miles air-line distance west of Cloncurry (135 miles by road). The Mount Elliott mine is at Selwyn, 71 miles south of Cloncurry. All these figures are correctly stated in the article.

A. W. NEWBERRY.

New York, N. Y.

Hanging Rocks and Earthquakes

THE EDITOR:

Sir—The accompanying view of "Anvil Rock" was taken several years ago by B. Thornton, of Unionville, Nev. This pedestal rock is one that formally existed previous to the earthquake of 1915, which knocked it down, as I have been informed. When I saw it some twenty-five years ago I was greatly impressed as to its importance geologically, and in this connection I have had it recalled to my mind in perusing Bulletin 760-A, which was recently issued by the U. S. Geological Survey. The locality where this rock stood as a pedestal is on the southwestern slope of Cinnabar Mountain, in Pershing County, Nev., and in the "East" Range, sometimes called "Piute" Range and again referred to as "Silver" Range. Dago Springs, on the road from Lovelock to Kennedy, Nev., is about two miles to the southwest of the site of the rock, which, perhaps, is within Township 28 North, Range 37 East, M. D. B. & M., unsurveyed.

Just what caused the erosion of the underlying portion of this rock it would be interesting to ferret out.

Anvil Rock, that stood in Pershing County, Nev., up to the 1915 earthquake

Since it stood upon the "hogback" of a side hill, I assume that erosion from water could have had little to do with it. It may be that it was due chiefly to and caused by abrasion of the sands from the Buena Vista desert that was carried by the winds which in this section blow from the southwest.

It is evident that during the time of the existence of this rock as a pedestal rock there must have been a long period of tranquillity as far as earthquakes of any consequence was concerned; certainly no such quake as that of 1915 had occurred for a long time previously. But when we couple this up with the story that the local Indians tell of a time when the earth shook so much that they had to lay on their stomachs, after being thrown to the ground, and hold on to the sage brush, we are reminded that perhaps it is not so long after all since erosion first began to make deep inroad into the underlying portion of the rock.

Since certain specific evidence, that I cannot well go into in this brief article, indicates that the present Piute tribe gained this territory by conquest of other tribes who were driven away, I am of the opinion that the Piute tribal history as it relates to this country does not date back a great length of time, perhaps not more than a few hundred years. If we accept the Piute history as being correct as regards the above-mentioned extraordinary earthquake, then it would appear that the erosion must have taken place very fast.

Lovelock, Nev. JOHN T. REID.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

THE first completely "electrified" open-pit iron mine has just been equipped by the Hanna Ore Mining Co. at Buhl, Minn. Shovels, trains and shops are run by electricity.

Resumption of operations at the Bully Hill mines and smelter in California is planned by a new company in succession to the Shasta Zinc & Copper Co.

Question is raised in Washington as to the desirability of a tariff on feldspar.

Sinking by the Tonopah-Keystone company in the western part of the Tonopah district marks the first of several development projects in that section.

Optioning a large area in the Rouyn gold district in Quebec by the McIntyre Porcupine company involves $1,000,000.

The new West Springs milling plant of the Anglo-American Corporation on the Rand has made an excellent start.

Completion of a new 100-ton flotation plant in the Lakeview district in Idaho is announced by the Hewer Mining Co.

Judgment for $177,065 has been rendered in favor of the O'Brien company in Cobalt against the La Rose. Ore wrongfully mined is involved.

New Company Will Operate Bully Hill Mine and Smelter

Property Shut Down by Shasta Zinc & Copper Co. in 1922—Interesting Metallurgical Problem

The California Zinc Co. has been organized to take over the Bully Hill mine and smelter at Winthrop, Calif., from the Shasta Zinc & Copper Co., and plans are under way for an early resumption of operations, according to S. Paul Ward, general superintendent of the smelter.

The property has had a checkered career. A blast furnace and converter plant was operated by J. R. DeLamar, until 1905, when the General Electric Co. became the owner. Difficulties included smelter-smoke litigation, involving suspension in 1910. Hydrometallurgical experimental work followed until 1915.

In 1917 control of the property was bought by Walter Arnstein, and a flotation mill was erected in 1919, to be shut down soon after. Hayden Stone & Co. and D. C. Jackling acquired an interest in 1921, the Shasta Zinc & Copper Co. was formed, experimental work was undertaken, and a roasting-reverberatory-baghouse plant was erected, based to a large extent on the process developed by R. G. Hall at Florence, Colo. In 1922 a refinery was added, but operations were suspended in November of that year. The metallurgical problem involved in the treatment of the ore are of considerable interest, zinc oxide being a major product.

A. D. Bryant is on the ground as general manager to represent the new company. He is accompanied by I. E. Behrman, construction engineer.

New, or at least additional, machinery is to be put in, the principal item being a sinterer. The sinterer is to take the product as it comes from the roaster, remove still more of the sulphur and make a sinter of the roaster output, thus shaping it up for better treatment in the reverberatory furnace plant.

Superintendent Ward, who was in charge of the smelter for a year before it was shut down, estimates that the monthly output under the new order will be 1,000 tons of zinc oxide and 500 tons of copper matte. The matte, he says, will carry $10 in gold to the ton and some silver. It will be shipped east for further treatment.

Advance Moffat Tunnel 1,423 Ft. in One Month

ALL tunnel-driving records of the world, it is claimed, are being broken by the crew of hard-rock miners under command of Daniel F. O'Rourke, who is driving the 8 by 8 "pioneer" tunnel for the six-mile bore under James Peak for the Moffat Railroad in Colorado. The crew is 119 ft. ahead of schedule, and has 629 ft. to its credit. According to the bonus system now in vogue to speed up the work, the fifty-one men must make 1,020 ft. per month, but they have made as high as 1,423 ft., according to O'Rourke, and they are establishing records that are startling the drilling world. The tunnel, says O'Rourke, will be finished in the fastest time on record for such a long bore of its nature.

O. L. Neer Is Operating Old San Nicholas Silver Mine

Checkered Career of Property in Northern Sonora—Good Flotation Concentrate Made

O. L. Neer and associates, after several months of development work and preliminary preparation have the mill at San Nicholas west of Cumpas in operation. The property is situated in northern Sonora, Mex. Good ore reserves are blocked out. At first only one shift was run at the mill on account of lack of water. Now two or three shifts will be worked. The mine originally was opened and worked by the Transvaal Company which hauled ore averaging 100 oz. silver, to Cumpas where it was smelted in a copper blast furnace. In 1917 a leasing company put in flotation and ran for about two years taking out about 400,000 oz. of silver.

Later H. C. Beauchamp, interested the Tonopah Belmont company in the property and a campaign of development was conducted mostly on the upper levels and away from the known workings. The company was unsuccessful in locating ore and gave up the option. Mr. Neer after several months effort was able to interest capital and start development on the lower levels where he felt sure ore of milling grade had been left after the mine was originally opened up. That his surmise was correct is borne out by the fact that enough milling ore has been blocked out for more than a year's run in the mill. Also some very high-grade shipping ore has been found. Milling results have been satisfactory. A 600-oz. concentrate is made, and the tailing is satisfactorily low.

Boom Spreads Westward in Tonopah Silver District

Sinking Started by Tonopah Keystone —Production for July $375,000— Tonopah "Ex" Leads

Many transactions are reported involving claims in the southwest portion of the Tonopah district and at least one company, the Tonopah Keystone Mines Co., which has acquired the ground immediately west of the West End Extension property, has been organized and is now being financed preparatory to shaft sinking. This company will probably start work before the end of August, under favorable conditions. The country is located for miles to the west of the new strike and undoubtedly other companies will soon be organized and begin prospecting and development work.

Developments in the West End Extension and Tonopah "76" properties by the West End company, which controls both companies by stock ownership and is operating their ground under lease, are reported to be very satisfactory. Development in important faces has been delayed by necessary dead work but will soon be resumed at a normal rate. One of the most favorable features of the West End Extension discovery is that the vein has already been traced to within less than 500 ft. of the surface and is still continuing upward strong and in ore.

Tonopah production for July was normal and, while detail figures are lacking on the production of some of the companies, indications are that production for the district will exceed 420,000 oz. gold-silver bullion with a gross value of about $375,000. The Tonopah Extension was by far the largest shipper, sending out 238,600 oz. valued at $196,000. The West End shipped 68,000 oz. valued at $60,000.

United Verde Makes Record Copper Production at Jerome

Production at the United Verde Copper Co. for the month of July exceeded 10,000,000 lb. of copper. This is a record output for the company's smelter and is far above the production records during the war-priced copper period. Stripping operations at the steam-shovel workings are nearing completion and the old fire-stope area is being opened for production. Four shovels are operating and a large part of the company's output is now coming from these pits. Shipments of ore to Humboldt have been started. Here the company has made arrangements with the Southwest Metals Co. for leasing its mill and flotation plant to conduct tests for determining the adaptability of the lower grade siliceous ores to concentration. Other shipments will also be made to the Inspiration Consolidated Copper Co.'s mill for further testing. It is reported that work will be started at once on a long tunnel that will be driven from the United Verde property through the Calumet and Jerome ground to the Venture claims, which prospect will be in entirely unexplored territory. This work is important.

McIntyre Take $1,000,000 Option in Rouyn Township

THE McIntyre Porcupine Mines, Ltd. of Porcupine, Ont., has taken an option on the Bathurst Gambly group of claims in South Pelletier Lake in the Rouyn gold district of Northwest Quebec. The total area embraced in the deal is 2,000 acres and the option price is understood to be $1,000,000. The payments are spread over a period of years and the cash consideration on taking over the option, was very small. Some spectacular showings of gold have recently been uncovered on this property, and the possibilities of development are large.

Drought Cut Gold and Diamond Production in British Guiana

Diamond Fields Grow With Further Exploration—May Have Airplane Transportation—Bauxite Active

Special Correspondence

Production of gold and diamonds in British Guiana for the first six months of 1924 was very much affected by a prolonged drought which began in February and lasted well into May. It not only made river navigation, the only means of access to the interior, difficult, but in some districts cut down the supply of water to such an extent that alluvial washers had to suspend operations.

From Jan. 1 to July 15 of this year 2,894 oz. of gold was exported, against 3,247 for the same period last year. The British Guiana Gold Co. went into liquidation early in July by the mutual consent of the creditors and stockholders. During the period mentioned, 81,083 carats of diamonds were exported, against 104,863 carats for the same period of 1923. Low water and a rush of miners to the new field in the Potaro district, where a 22¾ carat stone has been found, undoubtedly account for the smaller figures for this year.

The known limits of the diamond area are being rapidly increased and now extend almost entirely across the colony. Though only a few stones have been brought in from the Berbice River district, enough have been found to establish the fact that it is within the producing belt.

Major Harold Hemming, managing director of the Air Craft Operating Co., visited the colony late in June to ascertain the practicability of establishing an airplane service between Georgetown and the Mazaruni diamond district.

The Demerara Bauxite Co. is the only producer of bauxite. It exported 80,519 long tons up to July 15, against 39,689 long tons for the same period of last year. Practically all of this ore was cleared for New Orleans, from which port it is shipped to the East St. Louis plant of the Aluminum Company of America for use in the manufacture of the metal.

Menago Good Profit Earner in Cobalt District

New Ore on 1,025 Level—Nipissing Shipped 304,051 Oz. Silver in July —Keeley Output Normal

The Menago mine of Cobalt, which is owned by the Continental Mines, Ltd., is now making substantial profits. For the last three months they have averaged $15,000 a month. It is understood that for the month of June the profit will amount to $30,000. This is the result of new discoveries on the 1,025 level in the Keewatin below the diabase; this is probably the deepest level of the Cobalt camp, at the present time, from which silver is being recovered.

McKinley-Darragh is understood to be making a profit from mill heads which are running only 7 oz. to the ton and it is expected that for the present year total profits will be in the neighborhood of $20,000 to $30,000.

During the month of July the Nipissing mined 245,000 oz., of an estimated net value of $167,917 and shipped from the refinery bullion of an estimated net value of $204,713. There was no production of cobalt for the month. While no new veins have been discovered general development on the previously known veins has been encouraging; the low-grade mill treated 7,521 tons and the refinery shipped 304,051 oz. of silver.

In July the Keeley mine of South Lorrain maintained its average production and produced 143,367 oz. of silver and 22,738 lb. of cobalt.

Chalk Mountain Will Ship Fifth Car of Good Ore

The Chalk Mountain Silver-Lead Mines Co., whose mine is between the old camps of Fairview and Wonder in Nevada, is to sink its main working shaft from the present depth to 120 ft. to the 500 level. The oreshoot has been developed on the 30, 60 and 110 levels and has shown a maximum length of 200 ft. on the 110. The ore varies from 4 to 6 ft. in width. The average grade of roughly sorted ore, which has been shipped, is about $75 per ton. In addition to the shipping ore a considerable tonnage of mill ore has accumulated on the dump. It is estimated that water level will be reached at about 500 ft. and a zone of enrichment is anticipated at that depth. The company has already shipped four cars of ore and a fifth car will be ready in the near future.

Reorganized Kewanas Find in Goldfield Seems Important

The Reorganized Kewanas Mining Co., operating in the easterly part of the Goldfield district, reports finding of good ore, of shipping grade, over narrow widths, in the big vein which is now being developed on the 200 level. The shaft is to be sunk an additional 100 ft. at once so as to prospect the vein at that depth. Prominent mining men of Goldfield state that this is the most promising find that has been made in the Goldfield district for many years.

Spassky Copper Awaits Outcome of London Conference

Will Take Steps to Resume Operations in Russia When Agreement Is Reached

About the middle of 1923 the directors of the Spassky Copper Mine, Ltd., began negotiations with the Russian representatives in London to see if it were possible to come to an arrangement whereby the properties in Siberia could be returned under conditions permitting their operation on satisfactory lines, recites a recent circular to shareholders. These conversations were interrupted by the departure of Mr. Krassin, but they were resumed on the appointment of Mr. Rakovsky, his successor.

Subsequently, after the formal recognition of the Soviet Government by the British Government, it was decided by the latter to invite the Russian Government to send representatives to a conference in London, in an endeavor to settle outstanding questions in dispute between the two countries. The company negotiations were then suspended, because the directors thought that it would be irregular to continue separate and private negotiations with the Russian Trade Delegation during the sitting of the conference. This is still in session, although progress appears to be slow.

Certain aspects of economic life in Russia, however, are improving, it is stated. Famine has almost disappeared, and the railways are functioning better. But the directors of the Spassky company have no means of knowing anything as to conditions on the steppes of Siberia, where the mines are situated. As soon as an agreement is reached, the company's engineer and its business manager will be sent over to report. It is not anticipated that damage will have occurred to plant or property other than by time and weather.

Helmet Men Isolate New Fire in Copper Queen Mine

Fire was discovered in the Lowell mine of the Copper Queen branch, Phelps-Dodge operations at Bisbee, Ariz., on July 31 and, although it was at first believed to be a continuation of the recent fire at that mine, it was later found to be a new outbreak in an area entirely outside the old fire zone. Fumes of sulphur and burning timber were first noticed early in the week, but it was not until Thursday that the exact location of the fire was definitely determined.

Helmet crews from the Copper Queen organization and from the Calumet and Arizona Co. have been at work continuously constructing bulkheads and have now about effected a complete sealing on the 1,000, 1,100 and 1,200 levels. The area on fire is in an old stoped-out section and it is not believed to be capable of spreading to any great extent. Production at the mine has continued as usual and all men have remained at work except for a few that were working in the vicinity of the fire area. These were transferred to other work.

The Hewer concentrator near Lake View, Ida.
Since the photograph was taken the sides have been completed and the plant is ready to start. Flotation will be the method of recovery

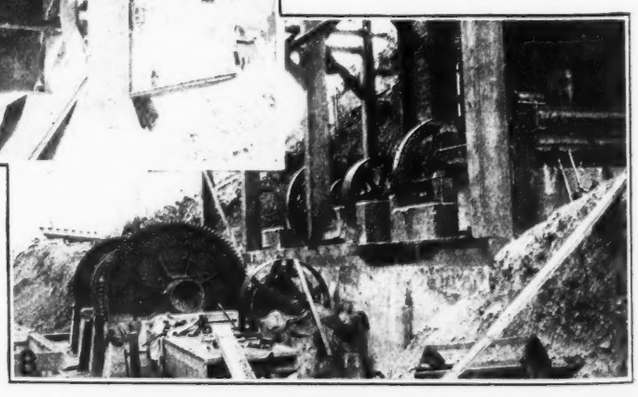
Hewer Mining Co. Finishes New 100-Ton Flotation Plant

Good Body of Silver-Lead Ore Developed—Situated in Pend Oreille District in Idaho—Dan Drumheller, Jr., in Charge of Operations

THE TURNING OVER of the machinery in a new 100-ton flotation plant early in August, marks the entry of the Hewer Mining Co. into the ranks of producers in Idaho. The property, situated 5½ miles southwest of Lakeview, on Lake Pend Oreille, includes a group of claims of which the Venzwela and Western Adventure form the nucleus. According to Dan Drumheller, Jr., manager of the company, the development work done to date has opened about 60,000 tons of reasonably certain ore. The principal oreshoot is 10 ft. wide and has been followed on the main adit level for 275 ft. Samples show an average metal content of 14.7 oz. silver, 0.03 oz. gold, 2 per cent lead, and 4.1 per cent zinc. A second shoot measures 95 ft. long on the adit level. It averages only 4 ft. thick, but the silver content is 17 oz. Crosscutting and raising on the vein shows it to be 30 ft. thick, strong and persistent throughout the 700 ft. of the present development. As the adit is extended into the hill the development of other oreshoots seems likely. The vein filling is shattered quartzite, with some quartz and siderite. The principal silver minerals are argentiferous tetrahedrite and pyrargarite. Galena and spahlerite also carry silver.

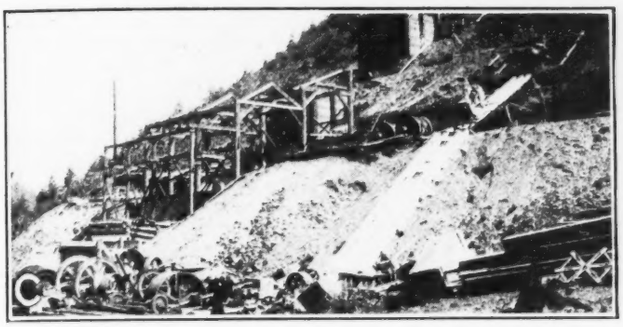
Milling tests made by the General Engineering Co., of Salt Lake City, show a 90 per cent recovery of silver and lead, with a concentration ratio of ten to one. In their report, these engineers declare that the ore is "very amenable to a simple method of flotation, and from experience we gained on the Talache ores, we feel quite safe in advising you that you will obtain better results in the mill than we have shown from the tests." Arrangements have been made for a license from the Minerals Separation, although another maker will supply the equipment.

Below — A construction picture showing the ball mills, compressor and engines in the Hewer plant

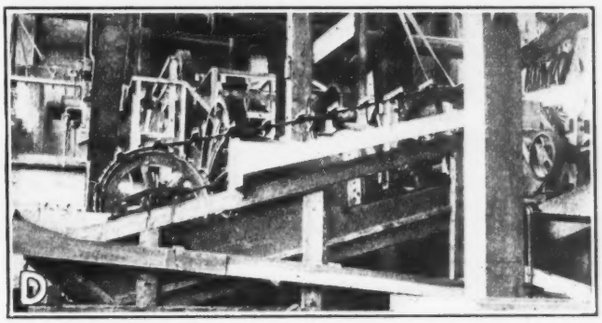


Above— In this more recent picture the belts are in place

The equipment in the new mill includes two 4x4-ft. ball mills, that will operate in closed circuit with McArthur classifiers; two mechanical flotation machines, rougher and cleaner; and equipment for thickening and drying the concentrate. An interesting feature is the McArthur mechanical classifier. The novelty of this device consists in the alternating raising and lowering of the inclined belt drag by means of eccentrics on the pulley shafts. The consquence is that the slime is given a free chance to drain down the incline as in the usual type of reciprocating rake classifier. A cleaner sand than is possible with a simple type of belt-drag is claimed for this device.



Construction of the Hewer concentrator was started only last spring



McArthur classifier in the foreground. Behind are the ball mills

Power will be generated by semi-Diesel oil engines, one of which can be seen in the accompanying photograph.

Mr. Drumheller believes that upon a basis of 100 tons of ore per day operating costs per ton will be about as follows: Mining, $1.75; milling, $1.50; overhead, 30c. With the current price of metals, the net smelter return is expected to be about $85 per ton of concentrate, or $8.50 per ton of ore. This would indicate a net profit of nearly $5 per ton of ore milled.

The enterprise has been financed largely by personal subscription from a group of Spokane mining men, among whom are R. K. Neill, in the public eye because of his connection with the Premier; W. Clayton Miller, former manager for the Federal Mining & Smelting Co., and Jerome Drumheller. Associates of Dan Drumheller, Jr., at the Talache mines are also financially interested in the company. These include Harry Hewer, Jack Benson, Harry Wilson, Oscar Williams, Jack Abrams, and A. J. Beckwith. All are practical and experienced miners of limited means, who have ventured their money in a project in which they have great faith. Around Spokane people wish them even better success than the present outlook indicates.

Burma Ruby Output Less

The Burma Ruby Mines, Ltd., during 1923 produced 1,000,501 carats of rubies, 63,943 carats of sapphires, and 25,812 carats of spinels, according to the Department of Commerce. The actual sales, as reported at the annual meeting of the company held in London amounted to rupees 824,053.

O'Brien Gets $177,065 Judgment Against La Rose at Cobalt

Involves O'Brien Ore Unintentionally Mined by Neighbor—No Allowance for Plant

An action brought by M. J. O'Brien, Ltd., against La Rose Mines, Ltd., both of Cobalt, Ont., has been decided by the local Master at Haileybury in favor of the plaintiffs who were awarded damages of $177,065. The court estimated the value of ores and minerals removed by the La Rose company from the O'Brien property at $209,594 and allowed the defendants $70,928 for mining these ores, and ruled that the La Rose should pay $38,400 as damages for other trespass upon its properties.

The court further held that the O'Brien property has not been enhanced in value by the erection of plant and machinery nor by the sinking of a shaft by the La Rose, which do not constitute permanent improvement, and therefore did not entitle the defendants to compensation. The dispute arose from the La Rose mistaking the boundary between its own holdings and the O'Brien property.

Northwest Magnesite May Make Caustic

Reports are current that the Northwest Magnesite Co. is prepairng to launch into the manufacture of caustic magnesite. Heretofore its output has been limited to the dead burned product. Such action, it is pointed out, would have a far-reaching effect upon the industry in California. Some are of the opinion that many California properties would not be able to compete with the Northwest company.

State Department Urges Prompt Trial for Sturtevant Murderer

Andres Lopez has been imprisoned and charged with the murder of Charles F. Sturtevant, American mine superintendent, who was killed at Mocorito, Sinaloa, Mex., on June 4, according to a letter from the Department of State to the *Mining Journal-Press*. The letter dated Aug. 8 says:

"You are informed that the American Consulate at Mazatlan reported to the Department, in a telegram dated June 6, that Mr. Charles F. Sturtevant, an American citizen, had been murdered on June 4 at Mocorito, State of Sinaloa, Mexico. Under date of June 7th, telegraphic instructions were sent to the American Embassy at Mexico City to advise the Mexican Foreign Office of the reported murder and urgently to request that immediate steps be taken to apprehend and punish the murderers. * * * The Department is in receipt of a mail despatch dated July 1, 1924, from the American Consul at Mazatlan, reporting that he has been advised by the Acting Governor of the State of Sinaloa that one Andres Lopez has been formally imprisoned charged with the murder of Mr. Sturtevant. Immediately upon the receipt of the Consul's despatch, telegraphic instructions were sent to the American Embassy at Mexico City to urge the Mexican Foreign Office to have the murderer of Mr. Sturtevant placed on trial without unnecessary delay."

Cripple Creek Output Still Far Ahead of 1923

Production from the Cripple Creek mining district for July showed a marked increase in tonnage over the previous month, but gave a gross value of $20,000 less. The gross value of the July output was $435,541, as compared with $338,995 for the same month in 1923. So far this year the monthly output has averaged about $100,000 greater than for like months last year, when the twelve months totaled $4,161,306.

Hanna Interests Get Second Iron Mine on Menominee

The Wickwire-Spencer Steel Corporration has transferred its lease to the Homer mine, on the Menominee range, in Michigan, to the M. A. Hanna Co. This is the second mine acquired recently in that field by the Hanna interests, the other being the Bates property. George Cannon, who was assistant to the manager in Duluth, has arrived in Iron River to take charge of the Hanna properties.

There was, it is said, some difficulty between the fee-owners and the operators regarding the way the Homer mine was being worked, with lawsuits in the courts, and it is thought that the transfer of the lease to the Hanna interests was an outcome of these troubles.

First "Electrified" Iron Mine Starts in Minnesota

THE first open-pit iron ore mine in the United States to use electricity as its sole power was in operation at Buhl, Minn., on Aug. 13, following on official demonstration for a party of mining and electrical engineers.

Electrification of the Wabigon mine of the Hanna Ore Mining Co., started July 7, and has just been completed. All the operations of getting out ore are done by electricity. Electric shovels remove the ore into cars drawn by electric locomotives.

Two electric shovels, three electric locomotives of 60-ton capacity each and completely electrified shops were shown the engineers.

The electric shovels dig a cubic yard of ore for half a cent, compared to two and one-half cents for steam shovels, while the electric locomotives haul cars at half the cost, according to power company officials.

Want Commercial-Sized Oil-Shale Experimental Plant

Tests for the purpose of working out a successful method to make commercially profitable the extraction of oil from shale, are being conducted jointly by the Federal Bureau of Mines and the State of Colorado in the laboratories at the State University at Boulder.

Efforts will be made at the next session of Congress to secure a sufficient appropriation for the construction of an experimental retort of sufficient capacity to develop, if possible, a practical commercial method of extracting the crude oil from the shale.

Rear Admiral Harry H. Rousseau, chief of the civil engineering corps of the U. S. Navy, recently visited the state for the purpose of making a survey of the naval oil shale reserve, comprising about 45,000 acres in the western part of this state.

In stressing the importance of an adequate testing plant Admiral Rousseau said: "The point has been reached when it is impossible to do any more research work in extracting oil from shale until a plant of commercial size has been provided for the Bureau of Mines to work with."

Ford Expands on Iron Ranges

Henry Ford is to add twenty-two more houses to the settlement at his Imperial mine on the Marquette range in Michigan. Work will start at once. The Imperial is a steady shipper at present and Ford now has two 10,000-ton carriers on the Great Lakes taking ore from the Marquette docks to the furnaces at River Rouge, Detroit. The Rolling Mill mine, at Negaunee is also forwarding ore to Ford's plant. The Ford company is still employing diamond drills in its search for additional iron ore deposits on the Marquette range.

Washington News

By Paul Wooten
Special Correspondent

Tariff On Crude Feldspar Might Hurt Industry

Domestic Producers Could Compete With Canada—Need Is For Better Organization

There is reason to believe that the domestic producers of feldspar are laying plans preparatory to a demand for a tariff on crude feldspar. This action is prompted, it is understood, by the fact that some 15 per cent of the domestic consumption is being supplied from Canada. There are no importations of ground feldspar, since it is effectively barred by a duty of 30 per cent ad valorem.

Some of those familiar with the feldspar situation are of the opinion that a better way than a tariff exists for meeting the situation. Canadian feldspar deposits are in no sense superior to many of those in the United States. Labor is just as expensive there as at the points where these operations are conducted in the United States. Enormous reserves of feldspar are available from North Carolina to Maine and at other points in this country. The reason the Canadian product is in demand in the United States is because it is prepared with more care. The soda spar is sorted out. The quartz content is kept low.

The principal trouble in the United States seems to be too many producers. A considerable number of properties are struggling along attempting to continue operations and are not in a position, because of their high costs, to undergo the additional expense necessary to better grading. If consolidations could be effected in the industry, which would permit the operation of the more economical properties, these higher cost mines could be held in reserve. With the economies of large scale operations, the output easily could be kept of a quality equal to the Canadian feldspar and could be produced at a cost which the Canadians could not meet.

Since there can be no restraint of trade when producers and consumers get together, it is suggested that an excellent opportunity is presented in this situation for an agreement between producers and consumers whereby all of this important pottery material could be drawn from American sources.

Under such an arrangement, foreign competition would be excluded by securing greater efficiency in domestic production. If a tariff were levied, it would tend to multiply the small and inefficient producers.

Will Get Foreign Market Data

Guy C. Riddell, the chief of the minerals division of the Department of Commerce, is preparing individual questionnaires which are to be sent to the Department's commissioners in the countries offering the best markets for our non-ferrous metals. Mr. Riddell also is making preparation for the issuance of a weekly bulletin which will carry the comments of American consulors on the non-ferrous metal situation.

Bureau of Mines Factor in Cinema World

THE Bureau of Mines now has 1,367 reels of motion pictures in circulation. By November 1 this number will have increased to 1,627. Each reel is 1,000 ft. long. Each picture deals with some phase of mineral production. In addition the Bureau circulates 23 other pictures which are prepared by industrial concerns, but which have been approved by the Bureau as having important constructive value. The other films have been prepared entirely by the Bureau itself.

Chinese Antimony Shipments Will Be Interrupted Is Belief

Shipments of antimony from China are practically certain to be interrupted for a considerable period as a result of the floods in the Hunan Province, which produces 75 per cent of the world's antimony, according to officials in Washington. While the extent of the physical damage done by the floods is not known definitely, the location of the smelting plants is such as to make it practically certain that they were inundated.

Receipts of antimony will not be affected for 60 or 70 days following the flood as that length of time is required for the transit to this country.

It happens that stocks of antimony in this country are low but there is no danger of a serious shortage as the price soon would reach a point where Mexican production would be brought in. The Mexican properties are kept in excellent standby shape. Only a short time would be required for antimony from that source to reach the market, once that a profit is insured. If the curve of business should mount as rapidly as some are predicting, supplies would be attracted from France and Bolivia.

Silver Mining in Tombstone District Picks Up

Some revival of silver mining has occurred in the Tombstone district, of Arizona, due to the recent favorable outlook of the metal market. Regular shipments are being made from many leases that are being operated on the old Tombstone Consolidated property, now owned by the Phelps Dodge Corporation. Ore that was formerly handled through the Boone shaft is now being taken out at another located farther up the hill, due to the fact that the Boone shaft has caved. The ore bins have also been moved to the new location. Added activities are noted at many smaller properties and it is believed that this month's shipments will exceed the previous ones. Shipment of lead-silver ores from the Courtland-Gleeson district is also increasing.

Guanajuato Letter

By K. A. Cunningham
Special Correspondent

Workers Seem as Prosperous as Before the Revolution

Industry Benefits from Governmental Stability—Labor Law Acceptable to Mining Companies Likely

Guanajuato, Mex., Aug. 5—General conditions in this state are favorable enough to give rise to a growing feeling of optimism in all lines of industrial enterprise. The successful quelling by the Government of the late revolution has considerably increased the prestige of the administration, a factor which is bound to react to the benefit of legitimate activities. Elections for President and the National and State Assemblies were held in July without any untoward event, good order having been maintained everywhere. The official announcement of the result of the election for president will show that General Plutarco Elias Calles is the successful candidate. The new president will take office in December.

There seems to be plenty of work for everybody throughout the state, and all classes appear well fed. A recent visitor, at one time a resident, remarked to me the other day that he had never seen the poorer classes looking so prosperous as they do today, and he knew the camp when it was booming, several years before the revolutionary period which began in 1910.

There has been no labor unrest nor trouble. Disputes between employers and workmen, or complaints on the part of the workmen, are being handled by the local Council of Conciliation and Arbitrage, and the decisions of this body have been on the whole fair and equitable. There seems to be a tendency on the part of the workmen not to appeal to the Council as frequently as was done at first when any rather absurd and injustifiable complaints were lodged.

The State Mine Labor Law, the object of which is to provide regulations to govern the application of Article 123 of the 1917 constitution in so far as the mining industry is affected thereby, has not yet passed the local Congress. A tentative law, agreeable to the mining operators was submitted to the Congress last year. For a number of reasons, the discussion of the bill was shelved from time to time until a few months ago, when, in a considerably altered form, it was passed and sent up to the Governor for his official approbation. Before giving this approbation, however, the State Executive summoned the chief operators of the state to a meeting at which the law was read to them. Certain articles having been objected to by the operators, the Governor appointed a commission to revise and re-draft the law. The commission was composed of representatives from the congress and of the mining industry. It met three times a week and worked hard for nearly three months, and in a spirit of give-and-take without serious friction, and, while the results cannot as yet be made public, it is understood upon very good authority that they are satisfactory to all the interests concerned. There is every reason to believe that the new draft will be passed without alteration by the recently elected State Congress which will assemble in September next.

Brisbane Letter

By Our Spcial Correspondent for Queensland, Australia

Scottish Gympie Dead; Famuos Gold District Done

Mt. Morgan Increases Output of Copper and Gold

Brisbane, July 14—The sequel to the closing down of the Scottish Gympie, and what may be regarded as the final stage in the history of this greatest of the gold producers of the once famous Gympie goldfield, has been the sale by auction of the plant and machinery of that mine. The different parts of the crushing mill and mine equipment were disposed of in "job lots," and the sale lasted four days. The value of the plant when it was in use was estimated at £80,000; the amount realized at the sale was £10,500, and the result is regarded as satisfactory. The Scottish Gympie Co., in the course of its thirty years of existence, won gold to the value of £2,200,000, and paid dividends totalling £598,000. This was the last of the important mines of the field to cease operations, and Gympie as a gold-mining center is practically dead. Fortunately, however, for its inhabitants, this place is surrounded by fertile lands, and as a farming and dairying district is more stable now than it ever was in what was considered its palmy gold-producing days.

The past few months have shown a slightly improving gold output in Queensland, and the half year has ended with an appreciable increase for that period. Mount Morgan was one of the contributors to that increase, which was also assisted by some better returns from one or two of the smaller goldfields. In the last six-weekly period the mine showed a fairly good increase, compared with the return for the like period of 1923, in the quantity both of the ore treated and the copper and gold recovered. Presumably, however, this big mine is still being operated at a loss.

B. Dunstan, Queensland geologist, in his recent report on the Mount Isa silver-lead field, mentions that of the five prevailing rocks of that region, the geology of which he describes as unique, are finely-grained quartzites, known as ribbonstones. Both in the disturbed and undisturbed strata the bedding lines, he says, are exceedingly narrow, even occasionally microscopic, and in the thickness of one inch as many as thirty bands have been counted—a feature characteristic of the unaltered limestones, the magnesites and the ribbonstones, as well as of the porous clays and ironstones.

London Letter

By W. A. Doman
Special Correspondent

West Springs Does Well With New Plant on Rand

Many Modern Features—Rubber-Lined Ball Mills—Fourteen Shillings Profit per Ton in July

London, Aug. 5—C. R. Davis, the consulting engineer of the Anglo-American group of mines, and his associates are to be congratulated upon the success which has attended their labors in connection with the West Springs plant. This newest Far Eastern contributor to the gold output of the Rand is equipped with probably the most up-to-date machinery in the world, comprising all the newest inventions and latest appliances, including rubber-lined tube mills. A preliminary run started in April, and everything worked smoothly, but it was not until July that a full month's work was done. The capacity of the mill is 40,000 tons monthly, witn facilities for expansion to 50,000 tons, and I understand that during last month 35,000 tons were treated, for a profit of £25,000, equal to about 14s. per ton. Details are not yet available, but unless costs are very low, the grade of ore crushed must be higher than that of the reserves, which are estimated at 7½ dwt. per ton. At any rate, it is a good beginning.

In January last the Bwana M'Kubwa Copper Mining Co., which owns a huge area in Northern Rhodesia (the ore reserves down to the 500 level are estimated at over 7,500,000 tons of a value of 3.9 per cent copper), increased its capital to £1,500,000 by the creation of 2,400,000 new ordinary shares of 5s. each. Apparently, the financing of the company, which has to send its production 1,450 miles by rail to Beira, was not completed, and I understand the Chartered Company, under its new form, is making arrangements to advance the necessary capital to bring the mine to the producing stage. The first unit of a plant constructed to treat the ore by the Perkins process, with a 500-ton daily capacity, is being erected.

It will be remembered that some time ago the Geduld area (Eastern Rand) was put up for tender, but owing to the exacting terms laid down by the then existing government, no tenders were offered. I hear now that the Union Corporation has made an offer for the area (2,641 claims), which is situated east of the Geduld property and southeast of the Modder East. Results on the Geduld have been uniformly good, and the company is a steady dividend payer, but the Modder East developments have been of a patchy character—so much so that selective mining has had to be resorted to in order to keep pace with financial requirements. Whether the new Labor Government will impose less onerous terms than did its predecessor on tenderers for new areas, remains to be seen, and the result of the proposed bargain will be awaited with interest.

Johannesburg Letter

By John Watson

Special Correspondent

Transvaal Platinum, Ltd., Finds Ore Assaying 199.1 Dwt.

Development in Quarter Totaled 1,186 Ft.—Good Values in No. 3 Winze —Second Line of Enrichment

Johannesburg, July 14 — Transvaal Platinum, Ltd., report, for the quarter ended June 30, shows the following development:

	Rietfontein No. 3 Farm	Welgevonden	Zuikerboschfontein	Total
Sinking	78 ft.	48	30	156
Crosscutting	133	117	..	250
Driving	469	311	..	780
Totals	680	476	30	1,186 ft.

Two drives were continued on the north lode Rietfontein, but disclosed no continuous stretches of ore. On the south lode, Rietfontein, consistent medium-grade ore was developed as follows: No. 7 winze, Rietfontein, W. drive, 58 ft. assaying 4.2 dwt. over 54 in.; No. 8 winze, Rietfontein, W. drive, 38 ft. assaying 3.0 dwt. over 46 in. The top 12 ft. of No. 6 winze averaged 15.8 dwt. over 57 in., the balance of the winze being poor.

The best values were opened up in the No. 3 winze area on Welgroonden. One line of enrichment was reported at the end of last quarter, which averaged 43.8 dwt. over 60 in. for 28 ft. of sampling. At that time, a second line of enrichment had just been struck. Since then exceptionally high values have been found. Forty-eight feet of sampled driving gave an average of 199.1 dwt. over 63 in. This is an average derived from the assay of 98 samples. The most pleasing feature of the development in this section, was the fact that good values were developed in the No. 3a winze, sunk below the 50-ft. level. From 50 ft. to 88 ft. down, this winze averaged 41.0 dwt. over 58 in. In the above, all values are in terms of platinoid, and no reduction has been made for abnormally high assays.

The Transvaal gold output for June was declared as 773,053 oz., having a value of £3,652,675. As compared with May, these figures show a decrease of 35,950 oz. in quantity and £163,854 in value. It must be remembered, however, that June has only thirty days and, this year, had five Sundays, leaving only twenty-five working days, whereas May had twenty-seven working days. The daily average output in June, 30,922 oz., is the best recorded this year. The price realized for the June gold has been taken at 94s. 6d. per ounce. The total output of Transvaal gold for the first six months of this year equals £22,366,071; whereas the total for the whole of 1923 (12 months) had a value of £39,061,604. The native labor returns show an increase of about 1,700 "boys," working on the gold mines, as compared with the end of May.

The following results for June, from the leading profit-earners on the Rand, have recently been published:

	Tons Crushed	Value, or Revenue	Costs per Ton Milled s.	d.	Estimated Profit
Government Areas	150,000	£328,842	17	7.4	£197,439
New Modder	117,000	255,075	17	3.3	154,030
Crown Mines	206,000	285,932	19	2.3	88,227
Van Ryn Deep	64,000	136,181	19	4.7	75,045
City Deep	99,500	186,512	22	9.0	73,344
Modder Deep	42,500	105,378	16	3.0	70,778
Randfontein Estates	206,000	251,537	18	2.2	65,448
Modder B	66,000	126,008	18	11.0	63,587
Springs	63,100	120,284	21	6.3	63,128
Brakpan	72,000	116,819	20	11.5	51,805
Geduld	69,000	112,921	18	9.0	48,160
Robinson Deep	71,300	.....	17	8.7	42,120
New State Areas	66,000	112,188	21	11.3	40,067

Drift 386½ Ft. in Month; Claim Idaho Record

TWELVE contract miners at the Minnie Moore mine, at Bellevue, Idaho, broke what is believed to be the state record for drifting in a single month in July. The old record was established in the Cœur d'Alene country twenty-one years ago, and has not been surpassed till now. It was 377 ft., whereas the new record at the Minnie Moore is 386½ ft.

The drift was run at the 800 level of an inclined shaft, starting 10 ft. from the shaft, and running entirely through solid granodiorite. Three shifts of four men each did the work, two men mucking back from the face, setting up and drilling a round, the other two mucking and tramming the rock, laying track, and carrying forward the water and air lines. A 248 Leyner water drill was used, mounted on a vertical column. A round of holes consisted of 16, averaging 6 ft. long. There were four upper cut holes, three lower cut, three breast, three back, and three lifters. The latter were loaded heavily in order to move all the muck possible back from the face and save time in setting up for the next round. A total of about 300 ft. of drilling per twenty-four hours was done. For ventilation a Sturtevant exhaust blower with a 10-in. pipe, so arranged that air could either be sucked out of the drift or blown in, was used. Directly after shooting the air was exhausted for about thirty minutes; then fresh air was blown in, and the next shift started work. R. B. McGinnis, manager at the Minnie Moore, was in charge of operation.

Michigan Copper Shipments for July 78 Per Cent of Output

Copper shipments by boat out of the Michigan district in July were 6,536,000 lb. Although the total is smaller than that for June, it is about normal for July. Calumet & Hecla Consolidated shipped 4,934,000 lb.; 1,106,000 lb. left the docks of the Michigan smelter, where Copper Range and Mohawk copper is refined; and Quincy shipped 496,000 lb. Shipments by boat, however, do not represent the total of deliveries from the district, as fully 2,000,000 lb., it is estimated, was shipped by rail. Deliveries, boat and rail, were about 78 per cent of July production.

Gold and Platinum? You Never Can Tell

An excitement resembling early stampedes to the mining camps of the West is prevailing in the Jack Creek country, about 8 miles from Bruneau, Idaho, where it is reported that gold and platinum have been discovered in a 45 ft. well on the ranch of Dee Black. On the strength of the report, which has not been verified, several thousand acres of land in the vicinity have been located and exploration has been started.

Goldfield Deep Mines Orders Centrifugal Pumps for Shaft

The Goldfield Deep Mines Co. of Goldfield, Nev., has placed orders for pumps, of centrifugal type, as well as necessary electrical equipment, for its deep shaft. Two Krough electrical sinking pumps, with a capacity of 400 gal. per minute each, under a head of 250 ft., have been ordered for the shaft, and four six-stage Roturbos, with a capacity of 400 gal. per minute each, under a head of 900 ft., have been ordered for station pumps. Two of the station pumps will be placed on the 800 level and two on the 1,600 level, thus giving a combined capacity of 800 gal. per minute from the 1,600 level to surface. As additional depth is gained in the shaft necessary pumps will be added. As soon as the pumps and other equipment are received and installed shaft sinking will be resumed below the 1,600, which is the present bottom of the shaft, the next objective being 2,400 ft. depth.

Hollinger Will Not Increase Tonnage to Maximum

The Hollinger Consolidated, at Porcupine, Ont. is treating 4,400 to 4,500 tons a day and mill heads are averaging more than $9 a ton. The new hoisting equipment which will permit of much greater tonnage will be completed by Oct. 1, and although at that time the capacity of the mill could be substantially increased and there should be plenty of power available, officials of the company state that no attempt will be made to increase production until the whole power situation is definitely settled. In this connection it may be stated that the Northern Canada Power Co. has given an option to E. R. Wood of the Dominion Securities Co., which has been involved in recent power financing. The Dominion Securities is understood to be associated with the Insulls of Chicago. The Quinze power plant is being tuned up and is now ready to deliver 10,000 hp.

Men You Should Know About

Dr. L. D. Ricketts is at Los Angeles.

Dr. C. N. Gould has been appointed director of the Oklahoma Geological Survey.

Thomas F. Cole of New York is on a business trip to the Michigan copper district.

Joseph Irving, Jr. is with the Southwestern Engineering Corporation, at Culver City, Calif.

M. R. Campbell and **W. T. Thom** are doing geologic work in the Lykens Valley anthracite field.

A. J. Collier has mapped the Buffalo anticline in Sweetwater county, Wyoming, for the U. S. Geological Survey.

F. S. Brownell, first vice-president of the American Smelting & Refining Co., is vacationing in the Pacific Northwest.

S. Paul Lindau, engineer for the Western Precipitation Co., has returned to Los Angeles from northern California.

C. F. Dike, general manager of the Cherokee Lead & Zinc Co., of Joplin, Mo., is recovering from an operation for appendicitis.

Charles R. Kuzell, smelter superintendent for the United Verde Copper Co., at Clarkdale, Ariz., was in San Francisco recently.

Henry Wyman has been appointed vice-president and general manager for the Pittsburgh Vetagrande Mining Co. of Zacatecas, Mexico.

Dr. E. M. Spreker, formerly of the U. S. Geological Survey, has been appointed assistant professor of geology at Ohio State University.

R. E. Allen, consulting geologist, accepted the position of director of exploration and development for the Landers Oil Company, Ltd.

D. C. Jackling, and **C. B. Lakenan,** general manager of the Nevada Consolidated Copper Co., visited Yellowstone Park together recently.

A. L. Eaton has resigned as general manager for El Potosi Mining Co. with which he has been connected for the past twenty-two years. **C. Q. Schlereth** succeeds Mr. Eaton.

N. H. Emmons, 2d, has returned from Annapolis, Mo., to his home in Framingham, Mass., after eight months' work as consulting engineer for the Annapolis Lead Co.

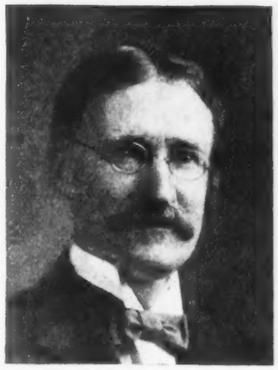
Charles A. Randall, who for the past year has been in charge of development for Schreiber Gold Mines, Ltd., is now designing a 100-ton mill for the Goudreau Gold Mines, Ltd., in Northern Ontario.

Henry Ritchie, who occupied the position of legal manager (secretary) of the Mount Bischoff Tin Mining Co., Tasmania, for fifty-two years, retired at the end of June. This looks like a world's record.

Robert Hughes, who has been employed at the Inspiration Consolidated Copper Co. for the last few years, has been appointed chief mining engineer of the Miami Copper Co. plant at Miami, Ariz.

F. H. Hamilton, chairman of the Huronian Belt Co., which controls the Keeley, Vipond and Canadian Lorrain properties, is coming to Ontario this month from London, to inspect the company's holdings.

B. B. Thayer, vice-president of the Anaconda Copper company and **C. F. Brooker,** chairman of the board of the American Brass Co., have been combining business and pleasure on a trip to Butte and other Montana districts.



F. L. Ransome

F. L. Ransome, who resigned his place with the U. S. Geological Survey some time ago, will this fall continue his duties at the head of the department of geology and mineralogy in the University of Arizona.

Alex F. Serebrovsky, director of oil operations for the Russion Government in Baku, has arrived in the United States and will make a tour of all of the oil fields of this country, visiting, also, some of the largest refineries.

Guy H. Moore, superintendent for the Chandler Mining Co., Ely, Minnesota, has resigned his position and will make his future home in California. **W. H. Nicholas,** mining captain at the property, has been placed temporarily in charge.

J. J. Forbes, the district engineer of the U. S. Bureau of Mines at Birmingham, Ala., is in Washington acting as engineer in charge of the division of mining research, in the absence of **M. Van Siclen,** who is in Oklahoma in connection with mineral land leases.

H. Charlton Dod, who is in charge of the operations of the South Australian Oil Wells Co., has written to the Australian press controverting the opinion of **E. M. di Villa,** a visiting geologist, that oil prospects are unfavorable in Victoria and South Australia.

Chester W. Brown, of the Union Oil Co. of California, who has been acting as chairman of the California standardization subcommittee, in a recent report has recommended uniformity of design and size of all the technical paraphernalia used in the drilling and operation of oil wells.

W. H. Corbould, for many years the chief representative of the Mount Elliott Copper Co., Queensland, and now general manager and a large shareholder of the Mount Isa Mines, Ltd. Cloncurry, left Australia at the end of June for England on a special mission for the latter company.

William Conibear, chief safety engineer for the Cleveland-Cliffs Iron Co., was re-elected chairman of the Lake Superior Section of the National Safety Council, at the recent meeting in Ironwood, Mich. He will make the arrangements and plan the program for the meeting to take place in Hibbing, Minn. in 1925.

James Campbell Miles, of Melbourne, Victoria, Australia, a mining prospector, discovered the Mount Isa mineral belt, in the Cloncurry district of North Queensland, that has become notable for its extensive and rich silver-lead deposits. When he dropped on the outcrop which has since been traced for over five miles, Mr. Miles was on his way for a prospecting tour to the Northern Territory, still further into the remote center of Australia; but while camped at the place which he afterward named Mount Isa, he, more for curiosity than anything else, napped off a bit of stone from this outcrop. All he knew about it was that it was mineral, but samples sent into Cloncurry for assay showed the stone to contain 65 per cent of lead and 73 oz. of silver per ton. He "fossicked around," had more samples tested, which went even better than the first ones, and secured a prospecting lease of 40 acres. The first Mount Isa company formed bought out his interests for a fair sum in cash and a good block of shares. The £20 shares have gone up to just on £60, and Mr. Miles profited to the extent of £50,000 to £70,000. After spending a three months' holiday in the southern states of Australia, he says he is "fed up" with cities, and in May last was on his way back to Mount Isa, whence he intends to resume his interrupted prospecting tour to the Northern Territory.

Obituary

Civiall Hawkins, general manager of the Celebration Co., at Hampton Plains, Western Australia, was burnt to death in the mine house on June 16. In the early days Mr. Hawkins was the accountant at the Lake View mine. He gave up this position to study mining engineering at the South Australian School of Mines, and then returned to Western Australia where he was associated with Richard Hamilton of the Great Boulder Company. He was a most conscientious man and a hard worker.

A. V. Hunter, mining man, banker and pioneer of Colorado, died in Denver on Aug. 12, at the age of 78.

Societies, Addresses, and Reports

Scientists Gather in Toronto

Over 2,500 Register for Annual Meeting of British Association—Six Hundred from Abroad—Many Geological and Engineering Papers

What is stated to be the most important body of scientists ever gathered together on this continent convened at the annual meeting of the British Association for the Advancement of Science, held in Toronto August 6 to 13. About six hundred transatlantic visitors, chiefly from Great Britain, attended the meeting, and the total registration of about 2,500 broke all previous records. There was a good representation from the United States, the Geological Survey sending some of its most eminent men, and there were also delegates from the various scientific societies and from the universities, several of whom presented interesting papers.

Great preparations were made around the University of Toronto Buildings to make the conference a success, and these included not only a adequate provision for the formal meetings, but also for the entertainment of the visitors by representative bodies of the City of Toronto, who entered into it with a wholesome enthusiasm and a large experience in matters of this kind.

The papers were divided into thirteen sections or groups so that a number of meetings were going on at the same time, in different buildings. The majority of the meetings were for the discussion of scientific matters only, but a number were also held to which the public was invited. These covered topics of general public interest and proved to be extremely popular.

The stage management of the whole meeting was excellent. Each section was in charge of a committee which convened every morning and arranged matters for the day. In characteristic British fashion the papers were presented on time, and, in order to provide every opportunity for discussion, this was arranged for a time subsequent to the paper, in case the speaker took up all the time allotted to him.

Many Geological and Engineering Papers

The formal opening was on Aug. 6, when Sir David Bruce, whose contributions to the advance of medical science have brought him into closer touch with the lives of the citizens in general than almost any other man, was the principal speaker.

A large number of papers were presented in the Geology and Engineering sections and several excursions were run. About 100 geologists visited the glacial and interglacial deposits in the Don Valley in the vicinity of Toronto, which are the most extensive and important interglacial formations in America. A geological trip was also made by about sixty members, to the Niagara-Grimsby district. Dr. J. S. Flett, Director of the Geological Survey of England and Dr. A. F. Ketson of the Gold Coast Geological Survey, accompanied the party.

Oil Shales Offer Geologists Opportunity

Prof. W. W. Watts of the Imperial College of Science, London, delivered the presidential address of the Geology Section and spoke on "Geology in the Service of Man." He stated that we criticised former generations for the wasteful handling of coal resources, but we had only ourselves to blame for the waste of oil and the destructive exploitation of oil fields. It was pointed out that, particularly in Canada, where the oil resources were limited, there were great areas of oil shales, and the part that they would some time play in building up the commercial prestige of the nation was emphasized. In this the geologist will play his part and to a large extent we are dependent upon him for the exploration of great areas of economic significance about which little is yet known. The increased use of artificial building material was also forecasted, as there are greater possibilities for the use of preservatives to counteract the action of the elements and the destructive gases in the cities.

Dr. G. S. Hume, of the Geological Survey of Canada, also referred to the possibilities of the oil shales and tar sands of Canada. The tar sands of Alberta cover an area of between 7,500 and 8,000 sq. mi., some portions of which carry 20 per cent bitumen and an oil content as high as 69 per cent. There are also large deposits of oil shales in New Brunswick and Nova Scotia, which in places yield 36 imperial gallons of oil per ton, as well as valuable byproducts.

Sir Thomas Holland, speaking on the Formation and Destruction of Mineral Resources, emphasized the wasteful methods of the present day and stated that mineral concentrations which took geologic ages to form, might be dissipated within a few generations. This process of drawing upon the accumulated capital of ages was leading to mineral bankruptcy, he said, and while famine conditions in a number of the metals was distant, it was none the less inevitable.

One of the most interesting features of the Geology section, were the several papers on the Pre-Cambrian. This was of particular interest to Canada, as this formation covers half of the entire surface of the country, or over 2,000,000 sq. mi., an exposure greater than all others in the world added together. It is of great economic importance because in it all the mines of Ontario, Manitoba and Quebec are located, and the extent to which it has been investigated to date is very small. The first gold development of Northern Ontario was only fourteen years ago, but during the present year Ontario gold mines will produce 50 per cent as much as the whole of the United States.

Professor M. B. Baker, of Kingston, in his paper on Metallogenesis and the Pre-Cambrian of Canada, stated that there were three great eras of time represented which are referred to as the lower, middle and upper Pre-Cambrian which were separated by two long periods of erosion and each of these three eras was brought to a close by marked igneous activity. It is noteworthy that the igneous intrusions at the end of the upper Pre-Cambrian were accompanied by great deposits of copper, nickel, silver, cobalt and iron, and similarly gold deposits accompanied the igneous activity which closed the middle Pre-Cambrian, but the igneous rocks which mark the close of the lower Pre-Cambrian show no evidence of mineral deposits of economic value. The economic future of the Pre-Cambrian in Canada depends on delimiting these highly differentiated igneous rocks that mark the close of the middle and upper Pre-Cambrian, followed by careful exploration of their contacts with suitable country rocks.

Several papers were presented in a discussion of the Pre-Cambrian Rocks of the World. Dr. W. G. Miller, discussing the most recent classification, stated that as the years go on this formation is of increasing scientific and economic interest, and that as the relationship of the rocks in the various countries is being unravelled, mineral production is being increased. Dr. J. S. Flett discussed the Pre-Cambrian in Britain and Sir Thomas Holland the same formation in India. He stated that as the whole Pre-Cambrian had been worked out more satisfactorily in Ontario than in any other part of the world, the classification there was taken as a guide in an attempt to find analogies in India. Several other papers were presented dealing with the Pre-Cambrian in Ontario, Quebec and Manitoba.

Mr. Louis D. Huntoon, speaking on the Gold Mines of Porcupine, stated that of the total value of the securities of the gold mines in Canada, 67.3 per cent was owned in Canada, 30.2 per cent in the United States and 2.3 per cent in Great Britain.

Following the completion of the meetings, a party of twenty-five geologists, traveling in a private car supplied by the Ontario Government, visited the different mining camps of Northern Ontario. They were followed on Aug. 17 by 400 visiting members travelling in two private trains, who are going through to Vancouver, stopping at Cobalt, Kirkland, Iroquois Falls and Porcupine, where half a day was spent in each place in order to give a general idea of the mining industry. The geologists will join this party at Porcupine and proceed west with them, the whole party to visit Sudbury on the return trip early in September. The large party will be accompanied as far as Timmins by the Hon. Charles McCrea, Minister of Mines, who has placed the whole resources of his department at its disposal.

Recent Technical Publications

Reviews, Abstracts, and References

Microscopic Methods — Microscopic methods have proved valuable assets in the study of low-grade ores, to determine the best method for recovery. A new instrument to assist in this work, known as a microsclerometer, has been devised by Ernest E. Fairbanks, and is described in *Reports of Investigations*, Serial No. 2,613, 6 pages, obtainable on request to the U. S. Bureau of Mines, Washington, D. C. A method of carrying out the work is outlined, with typical examples of its usefulness.

Gypsum—*Rock Products* (Chicago; price 25c. each issue) is running a series of articles by Alva Warren Tyler on "Modern Methods and Processes of Mining and Refining Gypsum." The first article in the June 14 issue covered the growth of the industry and the mining of the crude rock. In the July 12 issue, crushing, rock storage, and drying are discussed, and the next installment will cover screening, air separating, grinding, and calcining.

Mineral Resources—Recent separates of "Mineral Resources of the United States," issued by the U. S. Geological Survey, Washington, D. C., and obtainable on request, include: Introduction and summary of "Mineral Resources," 1921, Part I, Metals, and "Gold, Silver, Copper, and Lead in Alaska," 148 pages, by G. F. Loughlin and Alfred H. Brooks; "Gold, Silver, Copper, Lead, and Zinc in the Eastern States in 1923," 7 pages, by J. P. Dunlop; "Bauxite and Aluminum in 1923," 11 pages, by James M. Hill; "Petroleum in 1922," 79 pages, by G. B. Richardson; "Fluorspar and Cryolite in 1923," 14 pages, by Hubert W. Davis; and "Strontium in 1923," 4 pages, by George W. Stose.

Determining Iridium in Platinum—No. 483 of the Scientific Papers of the U. S. Bureau of Standards, Washington, D. C., 20 pages, discusses the "Determination of Iridium in Platinum Alloys by the Method of Fusion with Lead." It is by Raleigh Gilchrist. This is a critical study of the Deville and Stas method, a modified procedure being offered combining the best conditions for speed and accuracy in manipulation. Obtainable for 5c. from the Superintendent of Documents, Washington, D. C.

Hardness of Electro-deposited Metals—The Iron and Steel Institute, of England, has issued a 16-page bulletin by D. J. Macnaughtan, on "The Hardness of Electro-deposited Iron, Nickel, Cobalt, and Copper." The experimental work covers the Brinell hardness, microstructure, and conditions of production, and gives some consideration to the possible causes of the range of hardness obtained. Increased hardness is caused by decreased temperature, increased current density, decreased metal ion concentration, and increased hydrogen ion concentration.

Canadian Topographical Survey — The annual report of the Topographical Survey of Canada for 1922-23 has recently been issued, pp. 56, obtainable free from the Minister of the Interior, Ottawa.

Transvaal Mining—The annual report of the Transvaal Chamber of Mines, Johannesburg, for 1923, is at hand.

Iron Ore Analyses—The Lake Superior Iron Ore Association, Union Trust Building, Cleveland, has recently issued its familiar annual booklet giving average cargo analyses of Lake Superior iron ores for the season of 1923. Obtainable on request.

South Africa—The Geological Survey of the Union of South Africa has issued Memoir No. 22, 384 pages, which is a "Subject Index to the Literature on the Geology and Mineral Resources of South Africa." The index will be valuable to those who may have occasion to refer to the literature of any subject embraced in this field. Copies may be obtained for 10s. from the Government Printing and Stationery Office, Pretoria.

Patents

Hydrometallurgy—No. 1,503,229. July 29, 1924. L. F. Clark, Potrerillos, Chile. Acid solutions are subjected to heat and pressure sufficient to precipitate contained impurities.

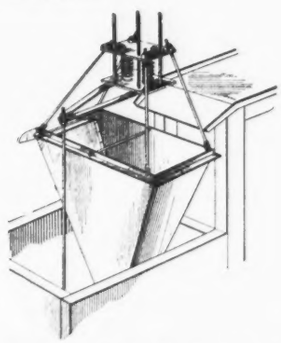
Petroleum — No. 1,502,416. July 22, 1924. J. S. Abercrombie, Houston, Tex. A fishing tool.

No. 1,502,955. July 29, 1924. G. C. Johnson, Wichita Falls, Tex. Design for an oil-well pump.

Concentrator — No. 1,500,192. July 8, 1924. A. H. Hollenbeck, Fair View, N. M., assignor of one-half to F. E. Vassar, Los Angeles, Calif. A belt concentrator, somewhat on the order of a vanner.

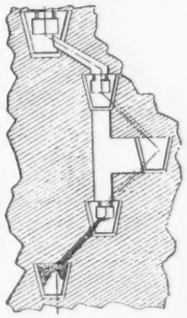
Vibrating Screen — No. 1,500,856. July 8, 1924. T. D. Walsh, Los Angeles, A screen, which is vibrated by an unbalanced rotor, a bumper and spring also being provided.

Classifier—No. 1,501,204. July 15, 1924. Fred De Mier, Picher, Okla. A box classifier of the design shown in the illustration.



Production of Sulphides—No. 1,502,213. July 22, 1924. Richard Rodrian, New York, assignor to Rodrian Electrometallurgical Co., New York. An electric current is passed through a solution of the hydrate of an alkali or alkaline earth, the surface of which is covered with ground sulphur, the object being the formation of sulphides from the sulphur.

Mining Method—No. 1,501,936. July 22, 1924. Edwin Ball, Birmingham, and C. E. Abbott, Bessemer, Ala. A method of mining consisting in driving a main slope beneath an inclined seam or deposit, turning levels laterally from the slope in the deposit, driving manways in advance of the main slope and substantially parallel to the center thereof, connecting the manways by levels in advance of the slope, and raising the slope from these levels.



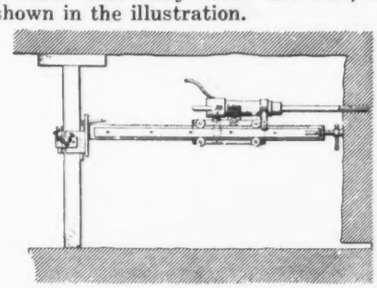
No. 1,502,030. July 22, 1924. S. J. Goodney, Crystal Falls, Mich. A method of mining soft ore consisting in sinking a shaft in the vein, extending a crosscut from the bottom of the shaft, digging a vertical raise which communicates with the crosscut, constructing a sub-level that communicates with the raise at one point, and constructing a second similar sublevel at a different elevation from and out of alignment with the first sublevel, thus relieving the portion of the ore adjacent to the sublevels from too great a strain.

Pulp Treatment—No. 1,502,656. July 29, 1924. W. O. Borcherdt, Austinville, Va., assignor to the New Jersey Zinc Co., New York. A tank adapted to contain a pulp, with means for effecting a gentle disturbance throughout the entire depth of pulp, and means for the separate removal of the settled solid particles and the supernatant liquor.

Ore Crusher—No. 1,503,157. July 29, 1924. Alexander Halliday, Prince Rupert, B. C. A roll crushing device.

Drilling — No. 1,501,630. July 15, 1924. F. S. Stoll, Los Angeles, assignor to W. W. Wilson, Los Angeles. Design for a rotary rock drill.

No. 1,502,383. July 22, 1924. Pietro Guerrini and Luigi Zaccaria, Nokomis, Ill. A drill support with track rails and a carriage for carrying the drill towards and away from the face, as shown in the illustration.



No. 1,501,917. July 22, 1924. A. E. Peters, Littleton, Colo., assignor to Ingersoll-Rand Co., Jersey City, N. J. An oiling device for drill sharpeners.

No. 1,501,918. July 22, 1924. A. E. Peters and M. S. Parkhill, Littleton, Colo., assignors to Ingersoll-Rand Co., Jersey City, N. J. A sharpener for drill steel.

New Machinery and Inventions

Japanese Buy New Magnetic Separating Machine

A new magnetic separating machine has been built for the South Manchurian Railway by the Magnetic Manufacturing Co., Milwaukee, Wis. It is known as the Type MW separator. It handles magnetite iron ore and similar materials. The principal feature of the machine is the design and construction of the magnet.

The material to be treated is spouted onto the vanner-edged conveyor belt either in the dry or wet condition, preferably wet. The feed strikes the belt just above the lower spray pipe. The spray pipes are arranged so that the volume of water is sufficient thoroughly to wash the material. As the material is fed onto the belt it immediately comes under the influence of the powerful magnet placed directly underneath. The magnetite is held against the surface of the belt and moves slowly in an upward direction, while the water moves in a downward direction. The iron in passing from pole to pole of the magnet turns over, which allows the water to flow freely through it, and the iron particles move sideways on the conveyor belt, first in one direction and then in another, as it passes through the device from pole to pole.

To effect an automatic discharge of the magnetic material, the magnet has been designed so as to allow the magnetic material to move gradually out of the magnetic field, and as it does so it mats to the surface of the conveyor belt until it reaches the discharge point, where it is washed off by the spray of water.

Materials can be treated by this type of concentrator ranging in size from about ¼ in. to extreme fines. To obtain the best results the material should be properly sized before treatment.

The separators are wound to operate on direct-current voltages up to 250 volts.

The machines are supplied with a switch panel mounted on the machine with the necessary control apparatus, so that the strength of the magnet can be increased or decreased to suit the conditions and to effect a satisfactory separation.

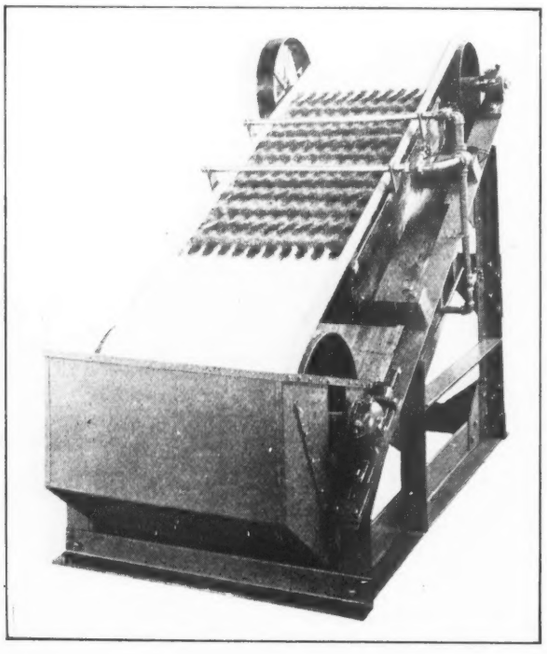
A Strong and Compact Spur-Gear Speed Transformer

A spur-gear speed transformer has been developed by the Hill Clutch Machine & Foundry Co., of Cleveland, Ohio, for such service as is essential in connection with conveyor drives, in mines, smelters, steel plants, refineries, cement mills, and in all general industrial work where speed-transformer units are operated, under continuous or heavy service conditions.

The transformer consists of a nest of plain spur gears revolving in oil, changing the revolutions per minute of the input shaft to some desired revolutions per minute of the output shaft. The power transmitted is the same in both shafts. The efficiency is high. The gears all have 20 deg. involute-form cut teeth, of short length and ample cross section.

All parts are easily accessible, as the cap and both ends can be quickly removed. The oiling arrangement is unique, being a continuous, and thorough splash-system lubrication is obtained by a metal disk on the high-speed shaft which automatically lubricates every gear and bearing in the case. The entire unit is inclosed and is dust-proof and leak-proof.

The speed transformer is made in seven sizes. It has been designated by the manufacturer as the "Industrial Type" transformer.



On this magnetic separating machine the feed strikes the vanner-edged belt just above the lower spray pipe. A magnet beneath the belt causes the magnetic particles to adhere. These particles turn over and over as they pass from pole to pole, thus insuring the liberation of the gangue.

Trade Catalogs

Clutches. Catalog L 28 of the W. A. Jones Foundry & Machine Co., Chicago, describes the Lemley friction clutch.

Machine Tools. Bulletin 1,305A of the Hisey-Wolf Machine Co., Cincinnati, Ohio, describes a new two-wheel 6-in. electric bench grinder.

Power Hammers. Blacksmith forging hammers of several types are described in the catalog recently received from the Blacker Engineering Co., with offices in the Grand Central Terminal, New York.

The General Electric Co. has issued a bulletin (Y-863B) giving a number of interesting views of its plants at Schenectady, Lynn, Pittsfield, Fort Wayne, Erie, and Bridgeport, and also of the Edison and National Lamp works.

Material Handling. Bulletin 98 of the Gifford-Wood Co., Hudson, N. Y., describes G-W material-handling equipment, including elevating and conveying machinery for various purposes, and equipment for handling coal and ashes.

Welding—The Oxweld Acetylene Co., Long Island City, Chicago, and San Francisco, has published a new 48-page catalog illustrating and describing in detail its extensive line of acetylene generators and oxy-acetylene welding, cutting, brazing, lead burning, heating, and decarbonizing apparatus and equipment.

Rubber Bearings. The B. F. Goodrich Rubber Co., Akron, Ohio, has issued Catalog No. 2 describing Cutless bearings and sealing rings of rubber. The Cutless bearing is similar to a metal bearing in design, except that it is lined with a tough, resilient, soft-rubber compound known as Olivite.

Furnace Arches. The M. A. Hofft Co. has just had issued a new booklet, describing in detail National furnace arches. In it is pointed out their lower maintenance costs, outstanding advantages, ease of installing, and replacements. It is obtainable by addressing the company at 814 West Washington Ave., Indianapolis, Ind.

Manganese Steel Castings. The American Manganese Steel Co., Chicago Heights, Ill., announces that its new specialized catalogs are ready for distribution. Catalog No. 5, just received, gives its complete line of manganese-steel castings for mines. This is but one of a series of nine. General Catalog No. 9 covers the entire ground so far (it is stated) as the unusually diversified character of the manganese steel founding industry permits.

Assayers, Materials and Laboratory Supplies. The Justinian Caire Co., of San Francisco, has recently issued its ninth illustrated catalog of assayers' and chemists' materials, mill supplies, and glassware. Specialties handled by this firm include Calkins' assay-office appliances, zinc shavings, resistance glassware, cyanide of potassium and cyanide of sodium, one-stamp mills, pure acids and chemicals, Hoskins' electric furnaces, oil-testing apparatus, hydrometers and thermometers.

The Market Report

Daily Prices of Metals

Aug.	Copper, N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
14	13.375@13.50	52.25	52 75	7.80	7.75@7.85	6.175@6.25
15	13 375@13.50	52.375	52.875	8.05	7.90	6.20
16	13.375@13.50	52 375	52.875	8.05	8.00	6.225
18	13.375@13.50	52 00	52.50	8.05	8 00	6.20@6.225
19	13 25@13.375	52.00	52.50	8.05	8.00	6 225
20	13.25@13.375	52.125	52 625	8.05	8.00	6.25
Av.	13.396	52.188	52.688	8.008	7.95	6.221

*These prices correspond to the following quotations for copper delivered: Aug. 14th to 18th, 13.625@13.75c.; 19th and 20th, 13.50@13.625c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Engineering and Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
14	63 7/8	64 7/8	68 1/4	253 3/4	254 3/4	33 1/8	32 1/2	32 1/2	32 1/2
15	63 3/4	64 3/4	68 1/4	256 1/4	257	33	32 1/4	32 5/8	32 1/2
18	63 5/8	64 5/8	68 1/4	255 3/4	256 1/2	33 1/8	32 3/8	32 3/4	32 1/2
19	63 3/8	64 3/8	68	255 3/4	256 3/4	33	32 1/4	32 5/8	32 3/8
20	63	64	67 3/4	258	259	33	32 3/8	33	32 5/8

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
14	4 54	68 3/8	33 15/16	91s 1d	18	4 53 1/4	68 3/8	33 13/16	91s
15	4.54	68	33 3/4	90s 8d	19	4 50 3/4	68 1/2	34 1/16	91s 7d
16	4.54 1/2	68 1/8	33 5/8		20	4 48 1/8	68 1/2	34 5/16	92s 3d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-quarter of a cent premium.

Lead, Zinc, and Tin Continue Advance—Copper Hesitates

New York, Aug. 20, 1924—Generally speaking, the non-ferrous metals have advanced further during the week ending today, though in the last two days the market has possibly not been so active as before. The signing of the Dawes agreement in London seems to have been fully discounted, for no sudden strength in any commodity market has ensued. Lead has been the strongest of the non-ferrous metals during the week; antimony has also exhibited a marked advance owing probably to the cutting off of supplies by the Chinese floods. Zinc and tin have increased slightly in price, tin going into new high ground for the current movement last Friday, though not above early spring levels. Silver has held fairly steady between 68 and 69c. Copper demand has fallen off and speculative offerings have depressed prices somewhat though producers are too well sold up to meet competition at present. An over-supply of bismuth in London has brought about a rather violent price decline in that metal.

Copper Demand Moderates

In the last two or three days a pronounced let-up has taken place in the demand for copper, both in this country and Europe. The London price for standard declined every day in the last week, which was somewhat disconcerting to American observers who had counted on improved buying as the reparations affair was straightened out. As we have pointed out before, however, this is something that will come about gradually. Producers generally have been asking 13¾c. delivered, all week, and some was sold even today at that price, but others could not get even 13⅝c. and at least one seller had large quantities for August-September shipment at 13½c., selling substantial tonnages at that level both yesterday and today. The speculative copper that was bought a few weeks ago is apparently now seeking a market, and though its amount has been magnified, it has helped to act as a brake on prices with most consumers out of the market for the time being. Manufacturers of copper report that the business boom that Wall Street has been discounting has not yet materialized to any extent and they see no reason for laying in large stocks of copper until it does.

Spot copper is slightly easier to obtain than forward, and last-quarter deliveries could hardly be obtained under 13⅝c. today, from any seller.

Lead at 8c. But No Lead

The official contract price for lead of the American Smelting & Refining Co. was advanced from 7.75 to 8c. on Friday, Aug. 15. This was in line with the tendency among other sellers, who promptly pushed their quotations still further upward. It would be interesting to know at what point the Smelting company's price could be set at a time like this to be on a parity with the so-called outside market. Limited amounts of lead are available from this producer at the 8c. level, and of course substantial tonnages are daily going into consumption on contract at that price, which fact is reflected in our quotation. Large consumers, however, would willingly take greatly increased allotments at the 8c. figure; they have been compelled to pay from 8.15 to 8.25c. for the small tonnages for which they have found themselves in immediate need. Dealers could probably not even buy at these prices today.

The St. Louis market has, of course, shared in the advance, producers there selling during the last three days on an 8c. basis, to consumers only.

Antimonial lead has been in particular demand.

Present lead prices are still well under Mexican import parity, which is around 8⅝c.

Galvanizers Buying Zinc

Some of the large galvanizing interests have come into the market with substantial orders recently, and some of the metal is still being sold for export. Prices have therefore advanced

moderately and today 6¼c. is generally asked, though business has been small. With higher ore prices, the profit for most smelters continues in the red. Brass special has been in only moderate demand lately at premiums of from 2½ to 7½c. per 100 lb. High-grade is 8@8¼c., delivered.

Hand to Mouth Buying in Tin

Tin seems to be going up though American consumers are not actively in the market except for such supplies as they are in immediate need for. One large interest is reported to have bought liberally in Singapore during the week.

Foreign Exchanges Lower

Profit taking, speculative selling, and offerings of large quantities of commercial bills, have depressed foreign exchanges. Closing cable quotations on Tuesday, Aug. 19, were 5.41c. for francs, and 4.4475c. for lire. Canadian dollars, ⅛ per cent discount.

Silver Undertone Good

Due to the absence of buying for several days last week, silver suffered a slump and prices in New York declined over 1 cent. At the lower level, however, India again came into the market and more than half of the loss has been recovered. Despite these fluctuations, the undertone is good.

Mexican Dollars: Aug. 14th, 52⅝c.; 15th, 52¼c; 16th, 52⅜c.; 18th, 52⅝c.; 19th, 52¾c.; 20th, 52¾c.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 28c. per lb.; 98 per cent, 26½@27c. London, £125 per long ton.

Antimony—Per lb.:
Chinese brands, 10¼@10½c.
W. C. C. brand, 12c.
Cookson's "C" grade, 12¼@12½c.
Chinese needle, lump, nominal, 8½@9c.
White oxide, Chinese, 99 per cent Sb_2O_3, 11@12c.
Demand has improved and floods in China have interfered with production.

Bismuth—London market declined on Aug. 18th from 10s. to 7s. 6d. per lb., and prices here have reflected the reduction. For ton lots, $2 per lb.; 500-lb. lots $2.15.

Cadmium—60c. per lb. London, 2s. 6d.

Cobalt—$2.50@$3 per lb. for spot.

Iridium—$260@$270 per oz.
Iridium alloyed with platinum, $280 @$286.

Nickel—27c. per lb. for 99 per cent virgin metal. London, £135 long ton.

Osmiridium—Crude, $58.50 per oz.

Osmium—$95@$104 per oz.

Palladium—$78@$83 per oz. Crude, $60 per oz.

Platinum:
Refined, $120 per oz.
Crude, $113@$114.
Market dull.

Quicksilver—$72 per 75-lb. flask. San Francisco wires $71.50; London, £13.

Rhodium—$85@$90 per oz.

Ruthenium—$40@$45 per oz.

The prices of Germanium Oxide, Magnesium, Molybdenum, Monel Metal, Radium, Selenium, Tellurium, Thallium, Tungsten and Zirconium are unchanged from the prices given in the Aug. 9 issue.

Metallic Ores

Chrome — $19@$22, depending upon grade and source. Nominal.

Manganese—42@46c. per long ton unit, seaport, c.i.f. Nominal.

Molybdenum—70c. per lb. of MoS_2 for 85 per cent concentrates. Nominal.

Tungsten Ore—Per unit, N. Y.:
High-grade wolframite, $8.50@$8.75.
High-grade scheelite, $9.
Ordinary grades, $8.25@$8.50. Nominal.

Iron Ore, Magnetite, Tantalum, and Vanadium are unchanged from Aug. 9 quotations.

Zinc and Lead Ore Markets Advance Further

Joplin, Mo., Aug. 16, 1924

Zinc Blende

High	$44.75
Premium, basis 60 per cent Zn.	$43 @ $43.50
Prime Western	$42 @ $42.50
Fines and slimes	$41 @ $38
Average settling price, all	$41.90

Lead Ores

High	$101.50
Basis 80 per cent lead	$105
Average settling price, all	$94.80

Shipments for the week: Blende, 16,837 tons; lead, 2,312 tons. Value, all ores for the week, $924,600.

Around 7,000 to 8,000 tons of blende was easily purchased on $42 basis Prime Western, but other sellers were slow to accept that price level and a few sold on $42.50 basis, while some declined to accept that offering. The production of lead was largely sold on the offering of $105 basis, while a few sellers decided to chance a further advance and withheld their ore from the market.

Platteville, Wis., Aug. 16, 1924

Zinc

	Per Ton
Blende, basis 60 per cent zinc	$44.50@$45.25

Lead

Basis 80 per cent lead $100

Shipments for the week: Blende, 674 tons; lead, none. Shipments for the year: Blende, 19,331; lead, 690 tons. Shipments for the week to separating plants, 1,170 tons blende.

Non-Metallic Minerals

Asbestos:
Crude No. 1—$300@$400.
Crude No. 2—$150@$225.
Spinning fibers—$90@$150.
Magnesia and compressed sheet fibers —$50@$90.
Shingle stock—$50@$60.
Paper stock —$25@$40.
Cement stock—$15@$20.
Floats—$6@$12.
All per short ton, f.o.b. mines, Quebec, tax and bags included.

No. 1 Rhodesian crude, $325; No. 2, $200 per short ton, c.i.f. New York.

Amblygonite, Barytes, Bauxite, Beryl, Borax, Celestite, Chalk, China Clay, Diatmaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Gypsum, Ilmenite, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Ozocerite, Phosphate, Potash, Pumice, Pyrites, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli and Zircon are unchanged from Aug. 9 prices.

Mineral Products

Arsenious Oxide (white arsenic)—7½@7¾c. per lb. Market quiet.

Copper Sulphate—4.75c. per lb. for domestic in carload lots.

Potassium Sulphate, Sodium Sulphate, Sodium Nitrate and Zinc Oxide are unchanged from Aug. 9 prices.

Ferro-Alloys

Ferromanganese—Reduced to $94@ $95 per gross ton. Rumors of $90 unsubstantiated.

Ferrochrome, Ferromolybdenum, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferre-uranium and Ferrovanadium are unchanged from the prices given in the Aug. 9 issue.

Metal Products

Copper — Sheets, 20⅝c. base; wire, 15½c.

Lead Sheets—Cut, 11c.; full, 10¾c. per lb.

Nickel Silver—18 per cent Grade A sheets, 26¾c.

Yellow Metal — Dimension sheets, 18¼c.; rods, 15¼c.

Zinc Sheets—Base price, $9.50 per 100 lb., f.o.b. plant.

Refractories

Bauxite Brick, Chrome Brick, Firebrick, Magnesite Brick, Magnesite Cement, Silica Brick, and Zirkite are unchanged from Aug. 9 prices.

Iron Trade Improving Slowly

Pittsburgh, Aug. 19, 1924.—Buying of steel has continued to increase, not at a rapid rate, but at a substantial one.

The increasing demand has had different effects on prices. In sheets there is more steadiness, the market being well defined now at 3.50c. for black, 4.60c. for galvanized, 2.60c. to 2.70c. for blue annealed and 4.75c. for automobile sheets, with few concessions, and those only in black and galvanized. On the other hand, increasing demand, through more strenuous competition, has depressed plates and shapes $2 a ton, prices in the Pittsburgh district being now 1.90c. to 2.00c. on plates and 2.00c. to 2.10c. on shapes. Bars remain firm at 2.15c. The alignment is very peculiar.

If steel mill operations have not yet reached a 50 per cent rate they will very shortly.

Pig Iron—The market, although still rather inactive, is described as very firm in price. The Standard Sanitary Manufacturing Co. is closing on fourth quarter requirements. Bessemer, $20, basic and foundry, $19, f.o.b. valley furnaces.

Connellsville Coke — The market is now quoted steady at $3 for prompt furnace and $4@$4.50 for prompt foundry, with prospects that $3.25 may be obtained on fourth quarter furnace.

Silver Market Aided by European Purchases

Circulation of New Coinage in Germany and Poland Likely to Stimulate Demand for More—Consumers Negotiate Directly With Producers—Buying of India and China Still Principal Factor

By Felix Edgar Wormser
Assistant Editor

IN RECENT WEEKS four American mining and smelting companies have sold an aggregate of 10,400,000 oz. of silver, partly to Poland (6,400,000 oz.) and partly to Germany (4,000,000 oz.). Other purchases have been made by Continental interests, presumably in anticipation of coinage requirements of other countries, notably Russia. This is the beginning of a tide which may reach a flood strong enough to cause many more millions of ounces to leave the United States to aid in rehabilitating the wrecked currencies of Europe. In 1920, it will be recalled, several European countries, especially Great Britain and Germany, were conspicuous by their efforts to sell silver melted from their coinage—an action which naturally had a depressing influence on the market. Great Britain did not actually ship its silver coinage, but released large quantities of the metal by recoining her silver currency and reducing the fineness from 925 to 500. Now the situation is reversed and Europe is calling for the silver discarded a few years ago.

It is noticeable that currency reorganization has preceded the purchases of silver by Poland and Germany. In the case of Poland a new monetary unit, the Zloty, has been established on a gold basis without outside financial support. Today Poland is one of the few countries of the world which may be considered to be on the gold basis or only slightly removed from it, the others being the United States, Switzerland, Sweden, Cuba, The Netherlands, Canada, and Mexico. Unless the currency of a nation is secure from violent depreciation it is useless to attempt the circulation of silver coinage, for the silver is immediately hoarded and disappears completely from view, being driven out by the worthless paper currency in circulation according to Gresham's law. If Poland's monetary affairs were in the condition they were in a few years ago, the introduction of silver coinage would prove impracticable. So far as Germany is concerned, the Dawes plan for reparations settlement provides as one of its main features that Germany shall have a sound currency maintained at all costs. Present German purchases are in expectation of the establishment of a sound medium of exchange.

One force that is likely to work decidedly in favor of the silver producer is the appetite which will be whetted by the circulation of the first silver coins among the European countries making the attempt. These coins will be eagerly seized after everything from aluminum to porcelain has been minted, circulated and found wanting. The call for silver is likely to be kept up until each country is saturated with the metal and the people have confidence that paper money can be readily exchanged for silver when demanded. Germany is being urged at the moment to begin the circulation of gold immediately after the Dawes bank becomes operative, which is a step beyond the circulation of silver. That additional purchases of silver will be made by Europe is a foregone conclusion. Germany is expected to buy about 25,000,000 oz. more, and will probably enter the New York market from time to time.

Although the sales to Poland provided for coinage to be done at the U. S. Mint, the contract with Germany contains no such provision. The practice in concluding these silver negotiations has been to base them upon the fixed price, although delivery will take place over many weeks and in varying quantities during the fall. The world market for silver has risen lately, partly on the strength of this Continental business.

Despite the fact that only four American silver mining and smelting selling companies participated in these sales, they are not the only companies to profit and have merely acted as agents for the many mining companies from which they draw their production. The syndicate, as it might be termed, comprised the American Smelting & Refining Co., the United States Smelting, Refining & Mining Co., the Anaconda Copper Mining Co., and the American Metal Co. The first three companies share equally in the allotment of sales, whereas the American Metal Co. has taken a relatively smaller commitment. The position of the largest factors in the silver producing industry is shown by the following table of production for 1922 and 1923. The American Metal Co. draws its production mainly from Mexico.

	1922, Oz.	1923, Oz.
American Smelting & Refining Co.	84,793,931	93,044,337
U. S. Smelting Refining & Mining Co.	19,736,742	23,472,403
Anaconda Copper Mining Co.	7,338,250	8,317,800

The output of the American Smelting & Refining Co. is chiefly derived from custom smelting, that of the U. S. Smelting & Refining Co. and Anaconda from their own operations more than from custom work. Although Anaconda was the world's greatest silver-mining company a few years ago, it was eclipsed in 1923 by Cerro de Pasco Copper Corporation, in Peru, which last year had a record production of 14,000,000 oz. The syndicate represents not only American production but Mexican and Canadian as well.

A striking characteristic of the transactions has been the fact that they were made directly with the consumers and without the participation of or handling through London. Of late years the tendency has been for American producers to break away from the habit of sending silver through London by shipping the metal directly to the Orient, where most of it is consumed. The following figures bear this out:

EXPORTS OF DOMESTIC AND FOREIGN SILVER FROM THE UNITED STATES

	To London	To India	To China and Hong Kong
1913	$41,596,000	$1,418,770	$1,114,000
1922	10,685,000	11,972,000	33,077,000
1923	6,319,000	23,721,000	38,310,000

The shipments of silver to London have decreased greatly, whereas those to Asia have jumped materially when compared with the 1913 status. In comparing these figures allowance must be made for the unit used, which is the dollar, not the ounce of silver. But even allowing for that difference, the trend toward direct shipments is apparent. The change is logical in view of the favorable location of such harbors as San Francisco, Seattle, and Vancouver in relation to trade with the Far East. Silver is now drawn from Mexico, Canada, and the United States and shipped regularly from these ports to the Orient in large amounts.

Although sales of silver to Europe have been the most prominent feature in the market, the fact should not be overlooked that the buying of India and China still gives the market its principal support. Month in and month out, year in and year out, the constant purchasing of one or both of these countries is the most important factor of the silver market.

Purchases by European countries are bound to be more or less irregular. It has been the Far Eastern buying, as usual, that has helped the market rise fairly steadily from 63c. last March to over 68c. at present. Higher prices have prevailed lately than for more than twenty-two months. Extremely moderate fluctuations have occurred compared with the violent fluctuations in the prices of other metals. The silver market is really a matter of foreign exchange, for silver is the money of millions of Chinese. Every advance or decline in the price of silver has an influence on the price level of Chinese products and thus upon the commerce of China, so that sharp fluctuations are not to be expected.

Mining Stocks

Week Ended August 16, 1924

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Alaska-Br. Col.	N. Y. Curb	*37	*37	*37		
Anaconda	New York	39¾	36⅝	39¼	De.15, Ja.21, Q	0.75
Arcadian Consol.	Boston	2	1⅞	2		
Aris. Com'l.	Boston	12	11¼	12	Jy.19, Jy.31	0.50
Calaveras	N. Y. Curb			1⅛		
Calumet & Arizona	Boston	54⅜	51⅛	54	Jn. 6, Ju. 23 Q	0.50
Cal. & Hecla (New)	Boston	18	17⅛	18	My. 31, Jn. 16	0.50
Canario Copper	N. Y. Curb	4	3½	3⅞		
Cerro de Pasco	New York	48½	46	48	Jy. 17, Au. 1	1.00
Chile Copper	New York	35	32⅛	34⅛	Se.3, Se.29, Q	0.62½
Chino	New York	21⅞	21⅛	21⅞	Sept., 1920,	0.37½
Con. Coppermines	N. Y. Curb	3⅜	3⅛	3⅛		
Copper Range	Boston	28½	27	28⅜	May, 1923	1.00
Crystal Copper	Boston Curb	90	83	*88		
Davis-Daly	Boston	*46	*45	*.45	Mar., 1920	0.25
East Butte	Boston	4⅜	4½	4⅜	Dec., 1919	0.50
First National	Boston Curb	37	35	37	Feb., 1919,	0.15
Franklin	Boston	*.75	*.70	*.70		
Gadsden Copper	Boston Curb	*60	*60	*60		
Granby Consol.	New York	19⅜	17½	19⅜	May, 1919	1.25
Greene-Cananea	New York	17⅞	14⅜	17⅛	Nov., 1920	0.50
Hancock	Boston			1⅞		
Howe Sound	N. Y. Curb	2⅞	2⅜	2⅛	Ap.1, Ap.15, Q	0.05
Inspiration Consol.	New York	28⅛	27	28¼	De.20, Ja.7, Q	0.50
Iron Cap	Boston Curb	3¼	3⅛	3⅛	May, 1923	0.15
Isle Royale	Boston	19	17	19	Se. 1, Se. 15.	0.50
Jerome Verde Dev.	N. Y. Curb	1	*96	1		
Jib Consol	N. Y. Curb	*78	*64	*74		
Kennecott	New York	49⅜	47⅝	48⅝	Jn.6, Jy. 1, Q	0.75
Keweenaw	Boston			1		
Lake Copper	Boston	2⅜	1⅞	2⅛		
Magma Copper	New York	37	33½	37	Jan., 1919	0.50
Mason Valley	N. Y. Curb	2	2	2		
Mass Consolidated	Boston			1	Nov., 1917	1.00
Miami Copper	New York	24⅜	23⅜	24⅛	Au.1, Au.15, Q	0.15
Mohawk	Boston	37½	34	37½	Se. 22, Oc. 13,	1.00
Mother Lode Coa.	New York	8⅛	8	8⅛	Jn.13, Jn.30	0.37½
Nevada Consol.	New York	15⅜	14	15⅜	Sept., 1920,	0.25
New Cornelia	Boston	22⅞	21⅝	22⅞	Au.8, Au.25,	0.25
New Dominion	N. Y. Curb			2⅛		
North Butte	Boston	5⅜	4⅞	5⅛	Oct., 1918,	0.25
Ohio Copper	N. Y. Curb	1⅛	1	1⅛		
Old Dominion	Boston	26¼	24⅛	26⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†101	†105	...	Jn.21, Jy.2 Q	1.00
Quincy	Boston	25⅛	24	25	Mar., 1920	1.00
Ray Consolidated	New York	13⅛	12⅜	12⅝	Dec., 1920	0.25
Ray Hercules	N. Y. Curb			*15		
St. Mary's Min. Ld.	Boston	39½	36⅜	39	Ap.22, My.20	3.00
Seneca Copper	New York	2⅛	2	2⅛		
Shannon	Boston	*70	*70	*70	Nov., 1917	0.25
Shattuck Arizona	New York	7⅞	7⅛	7⅛	Jan., 1920	0.25
Superior & Boston	Boston	*75	*46	*46		
Tenn. C. & C. cfs.	New York	8⅛	8⅛	8⅛	De.31, Ja.15, Q	0.25
United Verde Ex.	N. Y. Curb	29⅞	28	29⅞	Jy.3, Au.1	0.50
Utah Copper	New York	81	79⅝	79⅞	Jn.13, Jn.30,	1.00
Utah Metal & T.	Boston	*35	*31	*35	Dec., 1917	0.30
Victoria	Boston			*75		
Walker Mining	N. Y. Curb	3⅛	3	3⅛		
Winona	Boston	*50	*30	*30		
NICKEL-COPPER						
Internat. Nickel	New York	19⅜	17⅛	19⅛	Jy.17, Au.1, Q	1.50
Internat. Nickel pfd.	New York	88½	88	88½	Jy.17, Au.1, Q	1.50
LEAD						
Carnegie Lead & Zinc	Pittsburgh	4	3½	3⅞		
National Lead	New York	169½	157⅞	167⅛	Se.12, Se.30, Q	2.00
National Lead pfd.	New York	116½	116½	116½	Au. 22, Se. 15, Q	1.75
St. Joseph Lead	New York	29⅛	28	29⅛	Se. 9, Se.20	0.50
ZINC						
Am. Z. L. & S.	New York	9	8⅛	9	May, 1920	1.00
Am. Z. L. & S. pfd.	New York	31⅞	28	31⅞	Nov., 1920	1.50
Butte C. & Z.	New York	5¾	5⅛	5⅛	Mar., 1923	0.50
Butte & Superior	New York	18½	16⅜	18⅛	Je.15, Je. 30, Q	0.50
Callahan Zn-Ld.	New York	4	3⅞	4	Dec., 1920	0.50
New Jersey Zn.	N. Y. Curb	156	152½	156	May 10, 1924	2.00
United Zinc	N. Y. Curb			*25		
Yellow Pine	Los Angeles	60	60	60	June, 1924	0.04
SILVER						
Alvarado	N. Y. Curb	*90	*90	*90		
Beaver Consol.	Toronto	*14½	*14	*14½	May, 1920	0.03
Castle-Trethewey	Toronto	*77	*74½	*76½		
Coniagas	Toronto			1.30	Ap.20, My.1	0.02½
Crown Reserve	Toronto	*51½	*50½	*51	Jan., 1917	0.05
Keeley	Toronto	2.30	2.27	2.29		
Kerr Lake	N. Y. Curb	1⅞	1⅞	1⅞	Ap.1, Ap. 15, Q	0.12
La Rose	Toronto	*8	*8	*8	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.39	1.30	1.35		
McKinley-Dar.-Sav.	Toronto	*11¼	*10½	*11	Oct., 1920	0.03
Mining Corp. Can.	Toronto	2.45	2.40	2.40	Sept., 1919	0.12½
Nipissing	N. Y. Curb	6¼	5⅞	6⅛	Jn.30, Jy.21, Q	0.15
Ontario Silver	New York	7⅛	4¼	7⅛	Jan., 1919	0.50
Temiskaming	Toronto	*18½	*18	*18	Jan., 1920	0.40
GOLD						
Alaska Gold	New York	...	12½	...		
Alaska Juneau	New York	1	1	1		
Argonaut	Toronto	*37	*35½	*36½		
Carson Hill	Boston	1⅜	1⅛	1⅛		
Cresson Consol. G	N. Y. Curb	3 11/16	3⅜	3⅜	Jn.30, Jy.10, Q	0.10
Dome Mines	New York	15⅞	15½	15⅝	Jn.26, Jy 21, Q	0.50
Golden Cycle	Colo. Springs	1.33	1.32	1.32	My.31, Jn.10 Q	0.03
Hollinger Consol.	Toronto	13.90	13.90	13.90	Jy.24, Au.11, M	0.05
Homestake Mining	New York	42	41¼	41¼	Au.2, Au.25, M	0.50
Kirkland Lake	Toronto	*19½	*19	*19		
Lake Shore	Toronto	3.99	3.95	3.98	Se.1, Se.15, Q	0.05
McIntyre-Porcupine	New York	15⅞	15⅛	15⅛	Au. 1, Se. 1,	0.25
Newray	Toronto	*22	*20½	*21		
Portland	Colo. Springs	53	51	51	Oct., 1920	0.01
Teck-Hughes	Toronto	1.31	1.27	1.28		
Tom Reed	Los Angeles	27½	21	23	Dec., 1919	0.02
Tough-Oakes	Toronto	*61	*59	*60½		
United Eastern	N. Y. Curb	*42	*40	*41	Jy.18, Jy.31, Q	0.05
Vipond Cons.	Toronto	1.05	1.03	1.04		
Wright-Hargreaves	Toronto	3.85	3.75	3.80	Jn.16, Jy. 1, Q	0.02½
GOLD AND SILVER						
Black Oak	N. Y. Curb	1 1/16	*97	1 1/16		
Con. Cortez	N. Y. Curb	*18	*16	*16		
Con. Virginia	San Francisco	4½	3½	4½		
Continental Mines	N. Y. Curb			2½		
Dolores Esperanza	N. Y. Curb	*55	*51	*51	Jy. 1, Jy. 10 Q	0.05
Premier Gold	N. Y. Curb	2¼	2	2⅛	Jn.19, Jy.2	0.08
Tonopah Belmont	N. Y. Curb	*67	*63	*63	Apr., 1923	0.05
Tonopah Divide	N. Y. Curb	*29	*28	*29	Se.22, Oc. 10	0.10
Tonopah Extension	N. Y. Curb	2 1/16	2⅛	2 1/16	Jn. 10, Jy. 1	0.05
Tonopah Mining	N. Y. Curb	1⅛	1 1/16	1⅛	Ap. 6, Ap. 21	0.07½
Unity Gold	N. Y. Curb	1	*90	1		
West End Consol.	N. Y. Curb	...	...	*50	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	...	...	*50	June, 1918	0.02
SILVER-LEAD						
Ahumada	Boston Curb	6½	6	6	Jn.16, Jy. 2, X	0.15
Bingham Mines	Boston	...	...	16	Sept., 1919	0.25
Cardiff M. & M.	Salt Lake	...	...	*80	Dec., 1920	0.15
Chief Consol.	Boston Curb	2¼	2⅛	2⅛	Ap.19, My.1, Q	0.10
Columbus Rexall	Salt Lake	16½	16	16	Aug., 1920	0.03
Consol. M. & S.	Montreal	39⅜	30	30	Jn.30, Jy.15	0.75
Daly Mining	Salt Lake	...	...	2.25	July, 1920	0.10
Erupcion	Boston Curb	2⅛	2⅛	2⅛	Jn. 16, Jy.2, X	0.15
Federal M. & S.	New York	...	...	10⅛	Jan., 1909	1.50
Federal M. & S. pfd.	New York	50⅞	47½	50⅛	Au.25, Se.15, Q.	1.75
Florence Silver	Spokane	8⅞	8½	8⅝	Apr., 1919, QX	0.01
Hecla Mining	N. Y. Curb	9⅛	9	9	My.15, Jn.15,	0.25
Iron Blossom Con.	N. Y. Curb	...	...	*21	Oct., 1923	0.02
Marsh Mines	N. Y. Curb	...	...	*5	June, 1921	0.02½
Park City	Salt Lake	...	...	4.00	Jn.14, Jy.1,	0.15
Park Utah	N. Y. Curb	...	...	3½	Mo.15, Ap.1	0.15
Prince Consol.	Salt Lake	*6½	*6½	*6½	Nov., 1917	0.02
Silver King	N. Y. Curb	...	...	*75	Jn.20, Jy.1,	0.15
Silversmith	Spokane	*33	*30	*30	Jy.1, Jy. 10,	0.01
Tamarack-Custer	Spokane	1.49	1.22	1.29	Jn.25, Jn.30,	0.02
Tintic Standard	Salt Lake	6.05	5.75	6.00	Jy.28, '24, X	0.25
Utah-Apex	Boston	2⅛	2⅛	2⅛	June, 1923,	0.50
IRON						
Bethlehem Steel	New York	44	42⅞	43⅜	Jn.1, Jy.1, Q	1.25
Char. Iron	Detroit	....	....	*40		
Char. Iron pfd.	Detroit	....	....	2		
Colorado Fuel & Iron	New York	53	50¼	52½	Au.11, Au. 25 Q	2.00
Col. Fuel & Iron pfd.	New York	....	....	102	Feb., 1923	2.00
Gt. North'n Iron Ore	New York	31	29⅛	30⅛	De.10, De.27	2.00
Inland Steel	N. Y. Curb	....	....	46	Au.15, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	....	....	2⅛		
Replogle Steel	New York	12⅜	11⅜	11⅛		
Republic I. & S.	New York	49	46	48	May, 1921	1.50
Republic I. & S. pfd.	New York	88	87	88	Se.15, Oc.1, Q	1.75
Sloss-Sheffield S.&I.	New York	70	66⅛	69⅛	Jn.6, Jn.20, Q	1.50
Sloss-Shef. S &I.pfd.	New York	....	....	87	Jn.18, Jy.2, Q	1.75
U. S. Steel	New York	110	105¾	109⅜	Se.1, Se.29 QX	1.75
U. S. Steel pfd.	New York	121⅛	121	121⅛	Au. 5, Au. 30 Q	1.75
Virginia I. C. & C.	New York	37½	37⅛	37⅛	De.15, Ja. 2	1.50
Virginia I.C.&C.pfd.	New York	...	...	75	Jn.17, Jy.1	2.50
VANADIUM						
Vanadium Corp.	New York	24½	23⅛	24	Jan., 1921	1.00
ARSENIC						
Western Utah Copper	N. Y. Curb	*18	*15	*18		
ASBESTOS						
Asbestos Corp.	Montreal	31	24	31	Se.29, Oc.15 Q	1.00
Asbestos Corp. pfd.	Montreal	64	61	64	Jy.1, Jy.16, Q	1.50
SULPHUR						
Freeport Texas	New York	9	8⅛	8⅜	Nov., 1919,	1.00
Texas Gulf	New York	78½	73½	77⅞	My.31, Jn.14 QX	1.75
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4½	3⅞	3⅞		
MINING, SMELTING AND REFINING						
Amer. Metal	New York	48⅜	45	48⅜	Au. 18, Se. 2 Q	0.75
Amer. Metal pfd.	New York	112	112	112	Au.20, Se. 2, Q	1.75
Amer. Sm. & Ref.	New York	73⅜	68½	73⅜	Jy.11, Au. 1, Q	1.25
Amer.Sm.&Ref.pfd.	New York	104½	103¾	104½	Jy.11, Au. 1.	1.25
U. S. Sm. R. & M.	New York	32⅞	30	32⅞	Jan., 1921,	0.50
U.S. Sm. R.&M.pfd.	New York	44	44	44	Jy.7, Jy.15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial, X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Colorado Springs, Colorado Springs Stock Exchange.